

Designing an e-service for stroke patients — How can visualization support the management of the individual care process?

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Abstract

Background: An important factor in approaching the challenges of chronic diseases, requiring long-term management and high costs, is the active participation of the patient in the care process.

Objectives: Facing the problem of lacking patient-tailored, comprehensive health management software, the aim of this thesis is to generate ideas for a graphical user interface (GUI) to support stroke patients in the management of their individual care process. The objectives are to prototype a GUI for a patient e-service and to evaluate its usefulness and usability with stroke patients.

Methods: A scenario-based, user-centered design method was used to envision ideas for the user interface. Static prototypes were realized with the tool *Pencil* and for the implementation of a dynamic prototype web programming techniques were used. For the evaluation of the prototypes the methods of focus group discussion and cooperative evaluation were applied.

Results: The situation of a representative stroke patient and his interaction with the e-service were described in scenarios. Graphical user interfaces of the involved system views were derived from the scenarios and illustrated with static wireframe prototypes. A welcome screen, a care process timeline overview, and a diary with data sharing functionality were designed. The diary functionality was further examined by implementing a prototypical web application. During the evaluation, feedback for further improvements was gathered, and assumptions about the user's information and functionality needs could be verified.

Conclusion: The developed prototypes represent a suitable graphical user interface and visualizations to support stroke patients in the management of their care process. An overview of appointments on the welcome screen, a diary to document and monitor health, a timeline overview of all time-related health information and a selected sharing functionality were found to be important features of a personal health system for stroke patients.

Key words:

visualization, graphical user interface, patient empowerment, stroke, personal health systems

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Affirmation

I hereby affirm that this Master thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text. This work has not been submitted for any other degree or professional qualification except as specified; nor has it been published.

Heilbronn, 6 November 2012

Anja Perlich

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List of Abbreviations

EHR	electronic health record
EPR	electronic patient record
GUI	graphical user interface
HCI	human computer interaction
MVC	model view controller (software design pattern)
MVF	Mina vårdflöden
ODL	observations of daily living
PHI	personal health informatics
PHR	personal health record

Chapter 1

Introduction

An increase in the number of people with long-term health conditions is a big challenge for health and social care in industrialized nations. Stroke is one such condition. It requires continuous management over years and is related to high costs due to hospital and rehabilitation stays.

Truelsen et al. [1] reported that the number of stroke events is likely to increase in EU countries from 1.1 million per year in 2000 to more than 1.5 million per year in 2025.

Especially individuals with chronic diseases demand to follow up their care process. Higher patient involvement and active participation can lead to enhancement of the care management process. This in turn could have considerable economic benefits since chronic diseases compose the bulk of health care costs [2].

The internet, mobile technology, and in this context upcoming e-health techniques change the position of the patient as a passive consumer to an active participant of the health care process [3]. Today there are numerous ways for patients to be informed. Online patient portals for example allow interaction and communication between patients and health care providers, and social networks allow patients to compare notes and exchange experiences.

Koch and Vimarlund [3] described the patient empowerment through the improvements in their information, and increased participation and co-decision as a central aspect of personal health informatics (PHI). This domain studies the information use of patients and citizens to support self-care, prevention and lifestyle management. A central concept in PHI is the personal health record (PHR).

1.1 Problems

Although there are PHR systems providing information exchange with clinical records, there is yet no real re-architecting of health care services around the patient [4]. PHRs mostly represent a snapshot of the health care provider's electronic health record (EHR) without redesign [5].

Even though information is becoming more accessible to patients there are problems of understandability, inappropriate data selection, and presentation. Patient empowerment does not only include the access to information, but also 'building knowledge' and 'transforming knowledge into action' [5]. One important step to support this development is to turn applications from institution-centered into patient-centered. The information should not stand separately according to its source but should be

put in a context and merge into a big comprehensible picture, also in terms of appropriate visualizations.

Another problem is that there lacks a means for adapting the information supply as information needs along the care process change. This is especially important with chronic conditions because the information that is relevant for the patient changes over time.

In addition to problems concerning the way of presenting information there is a lack of functionalities for a selected sharing of information. This results in care providers not taking into account valuable information from the patient.

1.2 Objectives and Research Questions

The aim of this thesis is to generate ideas for a graphical user interface (GUI) to support stroke patients in the management of their individual care process.

Specifically, this thesis will address the following questions:

1. In stroke management large amounts of health and administrative data about the individual patient's care are produced by different actors. How can these data be presented in a meaningful way for the patient?
2. If the patient's pathway is defined as the optimal sequencing and timing of the care activities from his/her perspective, how can time visualization support the patient in following and forming his/her own pathway?
3. How can a web application be designed which allows patients to easily monitor their health?
4. How can selected data sharing between patients and care providers be supported through graphical user interfaces?

In order to reach the aim and to address the research questions this work has the following objectives:

- To prototype a GUI for a patient e-service
- To evaluate the usefulness and usability of the prototype with stroke patients

1.3 Research Context and Previous Work

The research for this thesis was done in the context of the Swedish project *Mina vårdflöden* (MVF), engl. *My Care Pathways*. One of the project's objectives is the creation of online citizen services that allow patients to follow, own (control) and manage their care processes for stroke, lung cancer, hip surgery and heart diseases [6].

The Health Informatics Centre (HIC) at Karolinska Institutet leads the research parts of *Mina vårdflöden* and previous work of HIC co-workers built the basis for this thesis. Hägglund et al. [7] conducted interviews and focus group meetings with stroke patients, gathered their experiences and anecdotes to capture the patient's needs for information access in relation to the care process. These

user stories were the basis for conceptual scenarios and personas in user-centered design activities.

The prototypes developed for this work were inspired by the conceptual scenario "Before the next visit or when I feel worse" (see appendix A.1). It consists of a vignette in which the patient, Patrik, reports the condition of his health using the e-service MVF in preparation for the upcoming visit with his doctor.

Patrik is with his 42 years a comparatively young patient who had a stroke three years ago. He lives together with his wife and two young children and wants to get back to a normal daily life. Due to the stroke he suffers from fatigue and concentration difficulties. Patrik uses modern technical devices actively and has high expectations of web-based health services to follow his blood pressure and life style data. (short description of the persona)

Based on the data collected in stroke patient workshops [7] and in a literature study about relevant patient data [8] Koch and Hägglund et al. identified the following potential services for *Mina vårdflöden*.

My Calendar. A service to keep track of care related or personal appointments, to get reminders for doctor appointments and care giver visits.

My Medicine. A service to keep an overview of the list of earlier and current drug prescriptions, to get information about drugs (e.g. contraindications) and prescriptions (e.g. retrieval date, reminders about renewal).

My Diary. A service to enter personal notes, keep track of the personal condition of the patient (e.g. problems, self-rehab activities, self-monitoring of medical data and life style factors), and to share that data with care givers.

My Care Providers. A service to manage contact data about physicians, institutions involved in the care process (e.g. hospital department, rehabilitation clinic), the stroke team, and nurses. Additionally, the service could contain dates of stays at different institutions and offer possibilities to compare and choose between different health care providers.

My Health Information. A service providing an overview of the patient's diagnoses, treatments, anamneses, and laboratory results in an understandable way.

My Information Flows. This service represents an excerpt of the patient journal concerning the flow of documents and information between different care givers (e.g. discharge summary). It should also enable the patient to keep track of referrals between different health care providers.

My Aids. A service containing information about the available and currently used technical and cognitive aids.

My Rights. A service helping to clarify the patient's rights in terms of care choice and guarantees.

1.4 Delimitations

Even though the project *Mina vårdflöden* aims to provide an e-service for the care processes of stroke, lung cancer, hip surgery, and heart disease, the focus of this work is on stroke patients only.

Furthermore, the research was restricted through the choice of one persona and one scenario; the focus fell on related functionalities. Even though the e-service should be accessible through different devices, the designed prototypes are dedicated for a computer browser.

The focus is on the e-service's GUI design and visualization; technical issues are not considered.

Chapter 2

Current Stroke Care

This section contains background information to the stroke disease, the related care process, and its effects on the patient. A differentiation is made between general stroke care pathways and a patient specific one.

2.1 Stroke and its Consequences for the Patient

A stroke is a brain injury caused by an abnormality of the blood supply to a part of the brain which may lead to rapid loss of brain function. There are two main types of stroke: hemorrhage (bleeding inside the skull) and ischemia (lack of blood) caused by blockage of vessels. The acute emergency of a stroke can be recognized by different symptoms which are addressed by the mnemonic *FAST*¹ [9]. The concerned person may suffer from sudden disturbances in facial expression, speech and coordination of movement. A fast treatment in the emergency unit is crucial for avoiding or limiting permanent damage.

After a stroke it is not easy to find reintegration in a normal life. There are physical impacts like paralysis or linguistic disorder, and impairment of cognitive performance. Often the person's attention, memory, retentiveness, and planning skills are affected. Memory deficits can result in problems in scheduling time sequences or in controlling the behavior [10].

When patients are discharged home from the hospital or rehabilitation institution they often feel not sufficiently enlightened and left alone with their new situation. It is excessively demanding to handle all the new information related to the disease and the possibility of looking things up at a later date is very important. Furthermore, there are problems in planning, organizing, and delivering care which involves several care providers from both health and social care. This also includes informal care givers, such as family members.

¹Facial weakness, Arm weakness, Speech difficulty, and Time to act

2.2 Stroke Care Process

The stroke care process starts with the time-critical acute phase where possible symptoms have to be evaluated, ideally in the emergency room. When the suspicion of stroke cannot be excluded a hospitalization respectively an admission to a stroke unit takes place. The patient stays inpatient for tests assessing the degree of damage of the brain.

According to, among other factors the stroke severity and care dependency, the patient is discharged to a rehabilitation clinic or released home with or without rehabilitation.

After coming home, a follow-up long-term care is needed and secondary prevention is essential. This is the part of the care process where the patients can contribute a lot themselves by keeping a diary about their health condition [11].

What is of importance in MVF is the care process from a patient perspective in consideration of *critical paths*. Coffey et al. [12] defined a critical path in quality management in health care as "the optimal sequencing and timing of intervention by physician, nurses, and other staff for a particular diagnosis or procedure". In MVF, the critical path from the perspective of the patient is in focus and in this thesis specifically the one of stroke.

2.3 Relevant Information for the Patient

Koch [8] found in a literature study of PHR-related publications that there is an interest in the illustration of the patient's health problems (diagnoses), treatments, care advices from providers, current and former medication, allergy data, vaccinations, and laboratory results. Furthermore, Koch sums up the patient's needs for functionality and requirements on information exchange between patients and care givers.

Since stroke patients have to deal with many different authorities such as doctors, nurses, stroke team, and institutions of care and rehabilitation an easy access to contact information and appointment reminders are desirable. Patients need a function to follow referrals to keep track of the flow of information and handover of responsibilities.

Also of relevance is information to patients about their individual rights, such as the rules and regulations that govern the access to care services [7]. Personalized information to support choices of care providers and services, taking into account factors like geographical information and doctor's specialization is wanted as well. Furthermore, the patient's information needs differ according to the different stages of the stroke care process.

Chapter 3

Documenting Patient Data

This section describes different types of electronic records in health care and existing systems to access information in these records.

3.1 Types of Patient Records

Electronic information about patient's health and treatments have been documented in many ways.

3.1.1 Electronic Patient Record

An electronic patient record (EPR) is a documentation system that contains data and documents related to the medical care of a patient at one certain health care institution [13].

3.1.2 Electronic Health Record

An electronic health record (EHR) contains all information captured by the EPR and in addition to these clinical data also health and lifestyle data. An EHR is a long-term record which is populated by all health care providers. The information is not related to a special case or institution, but is rather cross-institutional [13]. EHRs are managed by health care institutions and their purpose is to provide health information about a patient to health care providers [14].

3.1.3 Personal Health Record

In contrast to EHR, the personal health record actively involves the individual as an information source and receiver.

There are different meanings for the term *Personal Health Record* [15, 16, 17]. All agree on a PHR being an electronic, patient-centered system for health information with the following features:

- Access to information by the individual (and understandability)
- Management of the information by the individual
- Sharing of data by the individual

The record is ideally kept lifelong, covers the individual's entire health and is accessible via the internet. PHR systems can be maintained and controlled by the patient, health providers or third parties. The International Standardization Organization (ISO) defined the PHR key features to be "that it is under the control of the subject of care and that the information it contains is at least partly entered by the subject (consumer, patient)" [17].

There are different types concerning the dependence to the EHR; from standalone to tethered [14, 17]. Stand-alone PHR systems cannot interact with EHRs but offer an external user interface and data repository. A tethered PHR system is based on the care provider's existing infrastructure and allows patients to view their personal information through a patient portal. Interconnected PHR systems combine elements of the latter types and are most complex: data is stored in external third party repositories that users can control and to which health systems can connect. Developer tools offered by the vendor build the basis for a broad set of user functions linked to the PHR; data can be collected from multiple repositories and interpreted in various ways [18].

The basic requirements on PHR systems in terms of data operations are collection and storage. The functionality as a data repository can be extended to decision-support capabilities [14]. In the management of chronic conditions for example, the patient could make decisions guided by recommendations of the system. For such automatic computer processing the requirements go beyond functional to semantic interoperability.

Turning PHRs from data repositories into data interpreting systems supporting health decisions is one of the visions of *Project HealthDesign* [19]. This innovative program also emphasizes the importance of placing patients at the center of the design process of PHRs and coined the term *observations of daily living*.

Observations of daily living (ODL) are patterns and conditions of daily life, such as diet, physical activity, quality and quantity of sleep, experienced pain and mood [20]. ODLs are highly relevant for patients with long-term conditions.

The future MVF e-service is planned to fulfill the ISO PHR features and aims to a high integration of provider's records as well as non-clinical third party applications.

3.2 Existing Software Tools

This section gives an overview of proposed EHR visualizations for care givers and of the wide range of health software tools for individuals; from patient diaries over mobile apps to PHR systems.

3.2.1 Visualization of EHR Data

Plaisant et al. [22] developed *LifeLines*, a visualization environment for personal histories. Their approach of summarizing big amounts of time-related data in overview time lines should serve to an enhanced navigation and analysis of EPRs.

Shahar et al. [23] presented *KNAVE-II*, a system addressing the "data overload problem" of care

providers. It is a web-based, distributed system for interactive visualization and exploration of large amounts of time-oriented clinical data. A special feature is the possibility to browse both raw data and clinically meaningful concepts which are computed from the data and domain specific knowledge. In order to do that, the user has to select items in the domain's ontology represented as a file tree.

The *TimeLine* system presented by Bui et al. [32] is a problem-centric, temporal visualization dedicated to physicians and presents an integrated view of patient data from distributed data sources. The system is characterized by the reorganization of medical record information around medical disease entities and conditions. Furthermore, the visualization in *TimeLine* considers the context and specialization of the physician. Besides a graphical timeline the user interface contains demographic information about the patient, a medical problem list and a data viewer for viewing detailed reports, tables or images.

3.2.2 Health-related Tools for Individuals

The *Smart Diary Suite*¹ is an electronic journal extending the organizer to a health diary, nutritional tracker, and medication reminder. Due to smart phones with integrated sensors for GPS, motion and more, the number of mobile apps related to health purposes is growing very quickly. Many of them are service-oriented; *RunKeeper* to track and analyze traveled distances, *Sleep Cycle* to monitor sleep patterns and *GoMeals* to keep track of your nutrition.

Health 2.0 sites turn the individuals to 'prosumers' (producing and consuming information) in a network; an example is the site *PatientsLikeMe*². Patients share health issues with others through the internet without a direct connection to the mainstream health care system.

3.2.3 PHR Systems

In 2002, Kim et al. [24] evaluated eleven existing web-based PHR applications and stated that most of them were designed to serve as static repositories for personal medical information. One system they looked at is *WebMD*³ which belongs to the category of stand-alone PHRs [18].

*My HealtheVet*⁴ is an EHR-tethered PHR system dedicated to veterans providing them with health information and mechanisms to manage their personal health. Users can access parts of their medical records, enter and track health information and benefit from numerous online services [25].

Microsoft's PHR platform *HealthVault*⁵ enables individuals to store health information and share it with health care professionals or relatives. HealthVault provides storage and access functions, for emergency data and for family's health information, monitoring and sharing functions and the possibility to control the rights of access to the information. HealthVault partners with a variety of devices, applications and online services such as MSN's *My HealthInfo*⁶, and Mayo Clinic *Health Manager*⁷

¹Link: www.sdiary.com (last accessed October 25, 2012)

²Link: www.patientslikeme.com (last accessed October 25, 2012)

³Link: www.webmd.com (last accessed November 2, 2012)

⁴Link: www.myhealth.va.gov (last accessed November 2, 2012)

⁵Link: www.healthvault.com (last accessed November 2, 2012)

⁶Link: my-health-info.style.uk.msn.com (last accessed October 25, 2012)

⁷Link: www.healthmanager.mayoclinic.com (last accessed October 25, 2012)

which are based on the its storage and security infrastructure. The Health Manager stores all kinds of health data through the Microsoft platform and offers the users online features for the preparation of appointments and personalized health guidance, for example.

Google Health was a personal health record service from 2008 to 2011 and belonged as HealthVault to the interconnected PHRs [18].

Chapter 4

Methods

In order to address the research objectives of this thesis, user-centered scenario-based design and prototyping were used to develop a graphical user interface which was then evaluated using qualitative methodology in the form of focus group discussions and cooperative evaluation. As such, the work presented in this thesis can be situated in an early phase of the e-service development cycle, more specifically in the needs analysis to conceptual design and prototyping phases. What follows is a description of the methods applied to both develop and test the prototype.

4.1 Scenario-based Design Method

Benyon and Macaulay [26] described a design method for human-centered interaction design suitable for envisioning and designing novel systems. Their method is intended to be applied in the beginning of a system development project in order to discover and validate requirements, to specify the system's functionality and design. Figure 4.1 shows the lifecycle containing four types of scenarios in the highlighted boxes.

Conceptual scenarios are created by combining similar user stories and stripping away context. A conceptual scenario which describes the involved people, the activities undertaken, and the technology used in turn builds the basis for several concrete scenarios. These concrete scenarios are more specific and begin to dictate a particular interface design and allocation of functions between people and devices. At the end of the lifecycle stand system specifications in terms of functionality (use cases), look and feel (design language) and structure (conceptual object model). This work contributed to these specifications which build the basis for coding and implementing.

The research for this thesis started with the writing of concrete scenarios (cf. selection in figure 4.1).

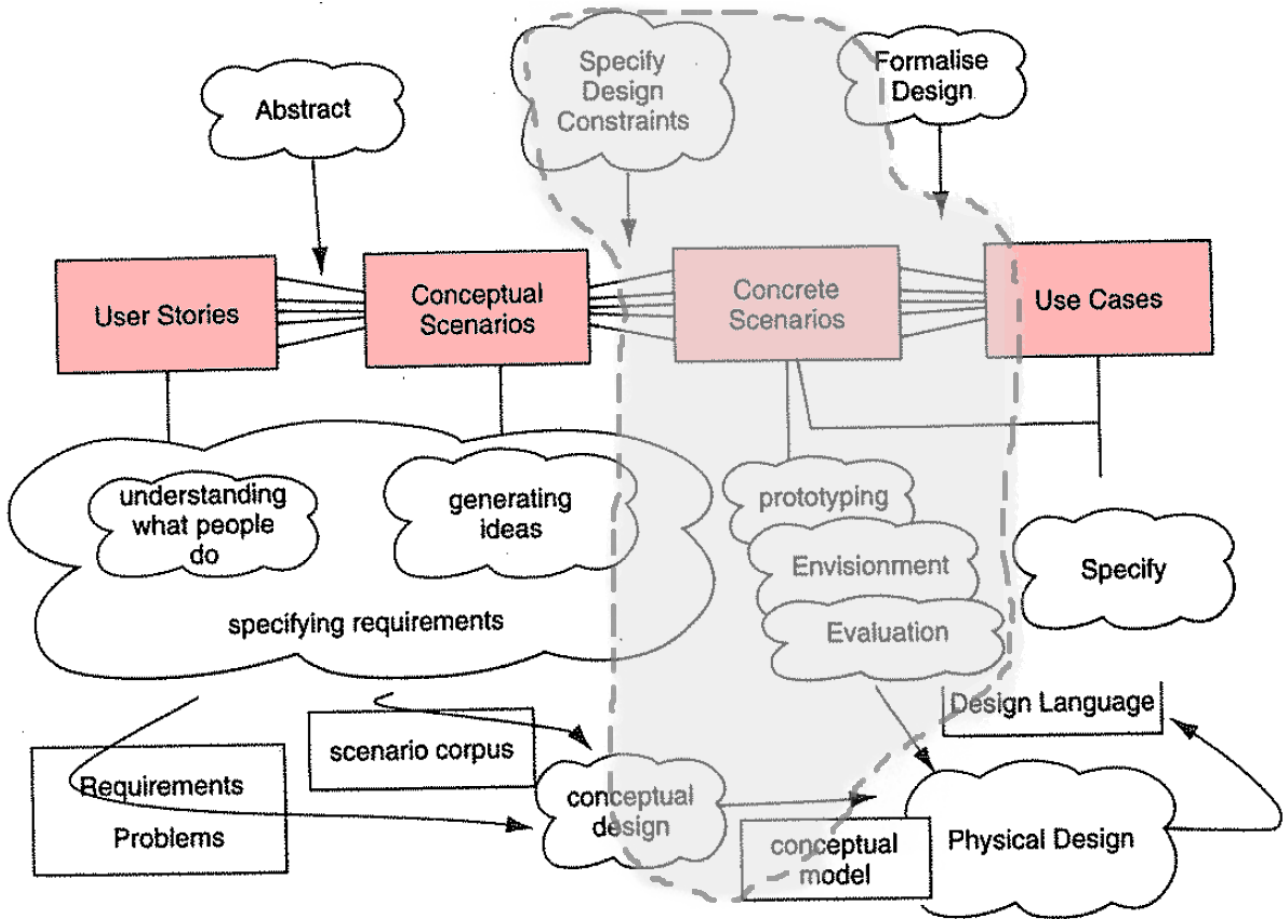


Figure 4.1: Overview of the scenario-based design method (adapted from [26]). The boxes contain artifacts (the highlighted ones are scenario types) and the clouds contain involved activities. The position of the work done for this thesis is pictured with the selection.

4.2 Prototyping Tools

The tools used for prototyping ranged from paper mock-ups to web programming techniques.

In order to get inspiration for the graphical user interface and to retain initial ideas, paper and pencil were used. Afterwards, these were refined and transformed into a digital representation with *Pencil* – an open-source GUI prototyping tool in form of a *Firefox* plug-in which allows the sketching of static mock-ups. Pencil provides predefined GUI shapes, the ability to links between views by clicking on assigned elements, and a HTML export function.

A dynamic prototype in the form of a web application simulating the diary function was developed using the open-source Eclipse IDE for Java EE and different frameworks. The Java Script Framework *Ext JS* (version 4.1, Sencha Inc., Redwood City) and their provided MVC (model view controller) architecture structure constituted a basis for the client side. To build up a server side for loading data (e.g. diary entries) from and storing it into JSON¹ files, the open-source *Spring* MVC Framework was used. *Tomcat* (version 7.0, Apache Software Foundation) was used as the server and servlet container.

¹JavaScript Object Notation

4.3 Evaluation Methods

The evaluation approach used was constructive in which feedback was sought about how the design could be improved. Given the intention to evaluate the usefulness of planned e-service functions in a static wireframe prototype with a larger scope, focus group discussion was used as an evaluation method. In order to test usability issues of a dynamic prototype with a restricted scope but deeper functionality, cooperative evaluation was used.

In both methods, the focus is on collecting data through discussion and observation about how users perceive and interact with the interface. The aim is to identify and verify user requirements and gather ideas for further improvements. The prototypes were translated into Swedish.

4.3.1 Focus Group Discussion

A focus group discussion is a method often associated with qualitative research. The purpose of a focus group discussion is to collect different opinions and perceptions. A group of people are invited to discuss a topic with which they are familiar in terms of experience or knowledge about the topic. A moderator guides and facilitates the discussion with prepared questions. A session usually should last for one and a half to two hours and should be recorded and analyzed on the basis of transcriptions [27].

The focus group discussion in this project was conducted by my Swedish colleague Maria Hägglund who had experiences in focus group discussion and was familiar with the participants. It was held in a meeting room at an establishment of Stockholm country council and lasted for two hours.

The basis for the discussion was the static prototype which was presented to the participants via video projector and print-outs. The focus group discussion was conducted with three of the four stroke patients that later on participated in the individual cooperative evaluation test. The fourth person who missed the focus group discussion was shown the static prototypes and interviewed before the cooperative evaluation session.

Data analysis

Data in the form of a digital audio recording of the focus group discussion was transcribed, translated into English and then analyzed in a qualitative analytic approach. Stewart et al. [28] described the *Scissor-and-Sort technique* as one type of content analysis on the basis of a focus group transcript. The first step is the initial reading at which sections are identified that are relevant to the research question. The second step is the development of a classification system.

In this study the participants' comments were assigned to four themes reflecting the four research questions (see 1.2) and to an additional theme: further user needs. The text was color-coded according these five themes, cut apart and grouped together. The last step is an interpretative analysis of the text pieces.

The comments of the fourth person, who did not participate in the cooperative evaluation but was asked for her opinion in an individual interview later, were also assigned to the five themes.

4.3.2 Cooperative Evaluation

Cooperative evaluation is an exploratory test to identify usability issues in early functional prototypes. The approach adopted in this thesis was described by Monk et al. [29]. Representative users work through representative, appropriate tasks which have been prepared by the design team. While performing these tasks, the test persons are encouraged to 'think aloud' — to explain to the observer what they are doing and why. The observer should try to explore the user's intentions and the subsequent interactions with the system. Special attention should be paid to unexpected behavior and expressions of confusion or puzzlement by the test person as these can hint at potential usability problems. Whereas in its pure form of *Think Aloud* the observer's influence is limited, in cooperative evaluation there is more interaction between the observer and the participant through the use of questions posed by the observer [29].

Prior to the cooperative evaluation sessions, the interfaces were pilot tested to identify more general issues that were not specific for the category of end-user. The cooperative evaluation sessions were conducted by my colleague Nadia Davoody as active observer. She speaks Swedish fluently and was familiar with the participants. I attended as a passive observer and recorded the pressing of keys that had no effect on the screen, for example. The open-source streaming video software *CamStudio* was used to record the screen.

Three cooperative evaluation sessions took place subsequent to the focus group discussion and the fourth session took place in a meeting room at Karoliska Institutet. During the individual sessions each participant performed six randomized tasks (A-F) written on file cards (see appendix B for task descriptions and order). Due to the limited number of test participants, a within-subject design was applied. Each person performed every task, but in a randomized order to limit the effect of learning transfer.

Each cooperative evaluation session was planned to last 60 minutes. The following steps were performed:

1. Introduction to the test procedure
2. Written questionnaire part 1
3. Small introduction to the diary prototype (GUI structure, three entry types and how they can be created)
4. User performed tasks (30min)
5. Written questionnaire part 2
6. Debriefing with oral questions

Data analysis

Data in the form of a digital audio recording, screen capture videos and written notes about keyboard interaction was analyzed qualitatively. The focus lay on unexpected events and user comments expressing surprise, confusion, or irritation. Four main problems were identified and the according text parts assigned. The data from the written questionnaire and the oral debriefing interviews was summarized.

4.3.3 Study Participants

Participants who were involved in the two evaluations were Swedish. Three of them had suffered strokes and the fourth person experienced a stroke in her family (cf. table 4.1). This meant that three of them were representative of the intended end-user. They were all familiar with the MVF project and had been involved in the project since its inception. They were also familiar with the focus group discussion method and had previous experience with being interviewed.

Four participants is a suited number for cooperative evaluation. For the focus group discussion a number of six would have been optimal, but it was not possible to recruit more.

	Role	Gender	Age	Computer experience			Participated in
				Use of communication devices	Use of internet services	Use of social networks	
P1	Stroke patient (1 year since 1st stroke)	Female	81	Mobile phone, computer	Online banking	Facebook	Focus group, Cooperative Evaluation
P2	Stroke patient (8 years since 1st stroke)	Male	71	(no answer)	Online banking, e-mail, search	Facebook	Focus group, Cooperative Evaluation
P3	Stroke patient (10 years since 1st stroke)	Male	64	Mobile phone, computer	Online banking, e-mail, search	-	Pre-Interview about static prototype, Focus group, Cooperative Evaluation
P4	Informal caregiver (stroke in family)	Female	70	Mobile phone, computer	Online banking, e-mail, search	-	Individual Interview about static prototype, Cooperative Evaluation

Table 4.1: Overview of study participants

4.3.4 Ethical Consideration

There is a written patient's consent for the participation in the usability evaluation. The consent contains amongst other things the declaration that they are given the opportunity to withdraw at any point in the usability evaluation and that data reporting is done anonymously.

Possible test persons were invited to participate in the evaluation through the Stockholm Stroke Patient Organisation by e-mail with an attached information sheet. The sheet contained a short description of the prototypes, explained how the evaluation would take place, and provided practical information.

The studies related to *Mina vårdflöden* (in which this thesis is a part) have been ethically reviewed and approved (Ethical approval 2012/1386-31/1) by the Central Ethical Review Board, Stockholm.

Chapter 5

Results

The results of the work are presented in three sections.

5.1 Scenario-based Design

Following the approach of scenario-based design, concrete scenarios were derived from the conceptual scenario described under previous work (section 1.3). Subsequent to a short description of the concrete scenarios, this section contains the views of final static and dynamic prototypes and a detailed description of their functions.

5.1.1 Concrete Scenarios

The concrete scenarios describe how the persona *Patrik* (see description in section 1.3) interacts with the future MVF web application using a desktop computer and a smartphone. Four scenarios were written and a detailed description can be found in appendix A.2.

The first Scenario *Patrik feels worse and wants to find the cause* contains three sub-scenarios (see A.2.1). In the first part *Patrik writes in his diary about disturbing symptoms*, the login, the welcome screen, the diary, and the medication service are mentioned. The navigation and the creation of new entries in the diary are described. The latter differs partially from the final prototype. The review of drug side effects in *My Medication* was not realized in the prototypes. In the second part *Patrik wants to write a message to his doctor* the diary sharing function is described. However, the GUI description differs from the realization in the final prototype. In the last part of the first scenario *Patrik gets a proposal for the next doctor appointment*, Patrik uses a smartphone to answer an appointment request. This function was not implemented in the prototype.

In scenario number two *Before the next visit* (see A.2.2), Patrik receives an appointment reminder through the MVF app and uses the diary sharing function on his smartphone.

The third scenario *After the visit* (see A.2.3) describes how Patrik uploads a file in MVF taken with his smartphone.

Scenario four *Comparing parameters in the overview* (see A.2.4) describes the functions of the timeline and its possible settings.

All described interaction with a smartphone was not further explored or prototyped.

5.1.2 Static Prototype

The static prototype captures designs for a welcome screen, a diary with sharing functionality and a timeline overview. The mock-ups were kept simple, mostly in shades of grey and focused on functionality and understandability. The views have with the size of 800×600 pixels a rather low resolution.

The login view shown in figure 5.1 represents the entrance point to the e-service and was kept in an ordinary way. In Sweden the 'Personnummer' (engl. personal number) is used as identifier.

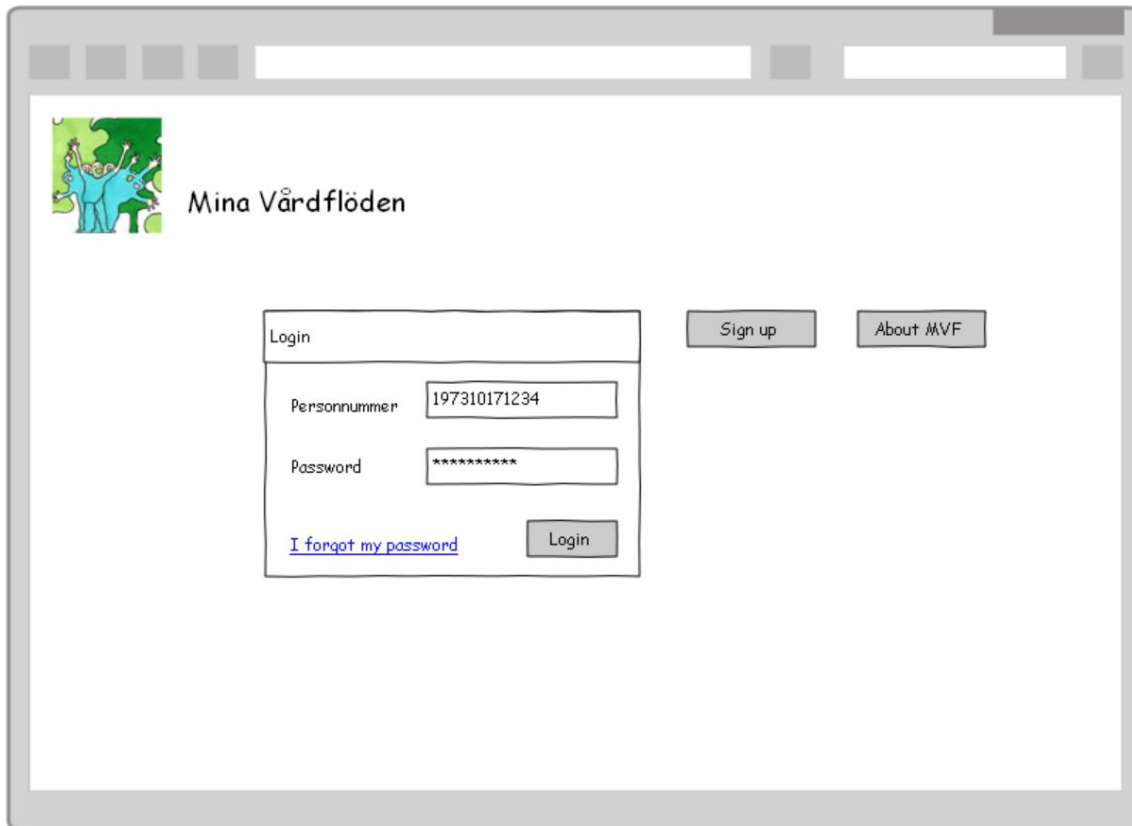


Figure 5.1: Login screen

The following views have the top bar in common as shown in figure 5.2. The logo and application name are on the top left. Below that are breadcrumbs to give the user a sense of location. There are buttons for searching, preferences and logout, and the name of the logged in person on the right.

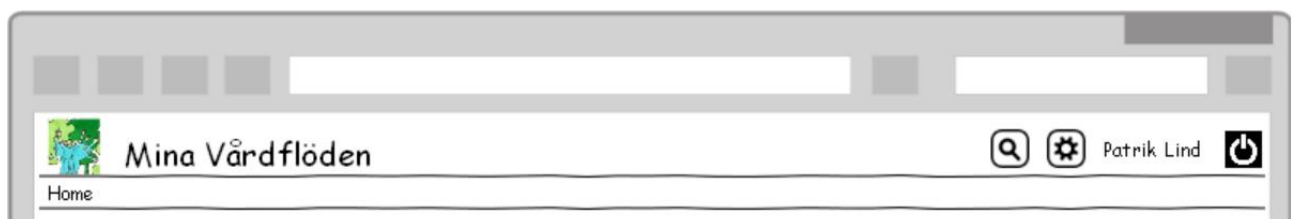


Figure 5.2: Top bar of the site.

Welcome Screen

After a successful login, the user gets to the welcome screen (see figure 5.3). There is a menu with links to the different services classed in three categories on the left.

My Own Data contains links to *My Diary* and to third party applications the patient subscribed to. *Health Care Data* is for the clinical data coming from care provider's records and contains *My Health Problems*, *My Therapy*, *My Anamnesis*, *My Lab Results* (primarily planned as a part of *My Health Information*), and *My Medication*.

Admin Data is for administrative data for the communication between the involved parties and the interfaces between patient and health care providers. It contains *My Care Givers* (primarily in 1.3 called *My Care Providers*), *My Referrals* (cf. *My Information Flows* in 1.3), *My Calendar*, *My Insurance*, *My Rights* and *My Care Options*. A link to *My Aids* (cf. section 1.3) is missing here.

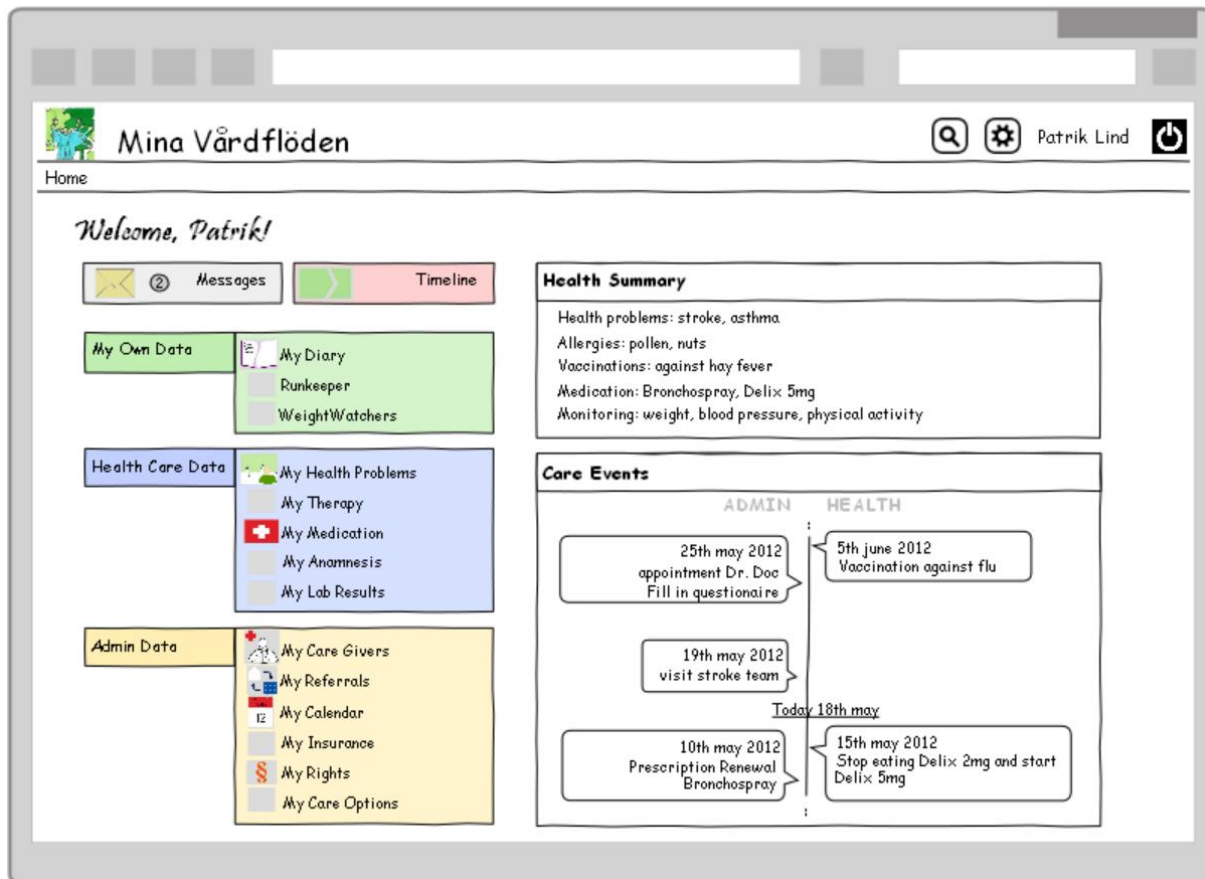
Above the menu there are two buttons. *Messages* leads to an e-mail software like view and *Timeline* leads to the timeline overview. Some attention-grabbing indicators should be added to the menu items when there is new information available. Each menu item contains an icon (cf. table 5.1.2) respectively a placeholder. Going into certain services the user should be able to tell where s/he is by several elements in the view, as the breadcrumbs, the name, the icon, and possibly by a certain color.

On the right, there are two boxes, *Health Summary* and *Care Events*. The health summary gives an overview of the current health state of the patient. This contains short information about the current health problems, allergies, vaccinations, medications, and parameters that are monitored by the patient. The care event box shows current events of the near past and future. The design of alternative A (see figure 5.4(a)) was inspired by the Facebook©timeline. The line is scrollable and contains administrative events, like doctor appointments, on the left and directly health-related events, like the change of a drug, on the right. The event overview is no replacement for a calendar but brings together extracts of certain services such as appointments, drug and prescription events, referrals, and changes of stays, like an admission to a rehab institution, for example. To provide details on demand the content in both overview boxes should be clickable and linked to detailed descriptions in the corresponding service.

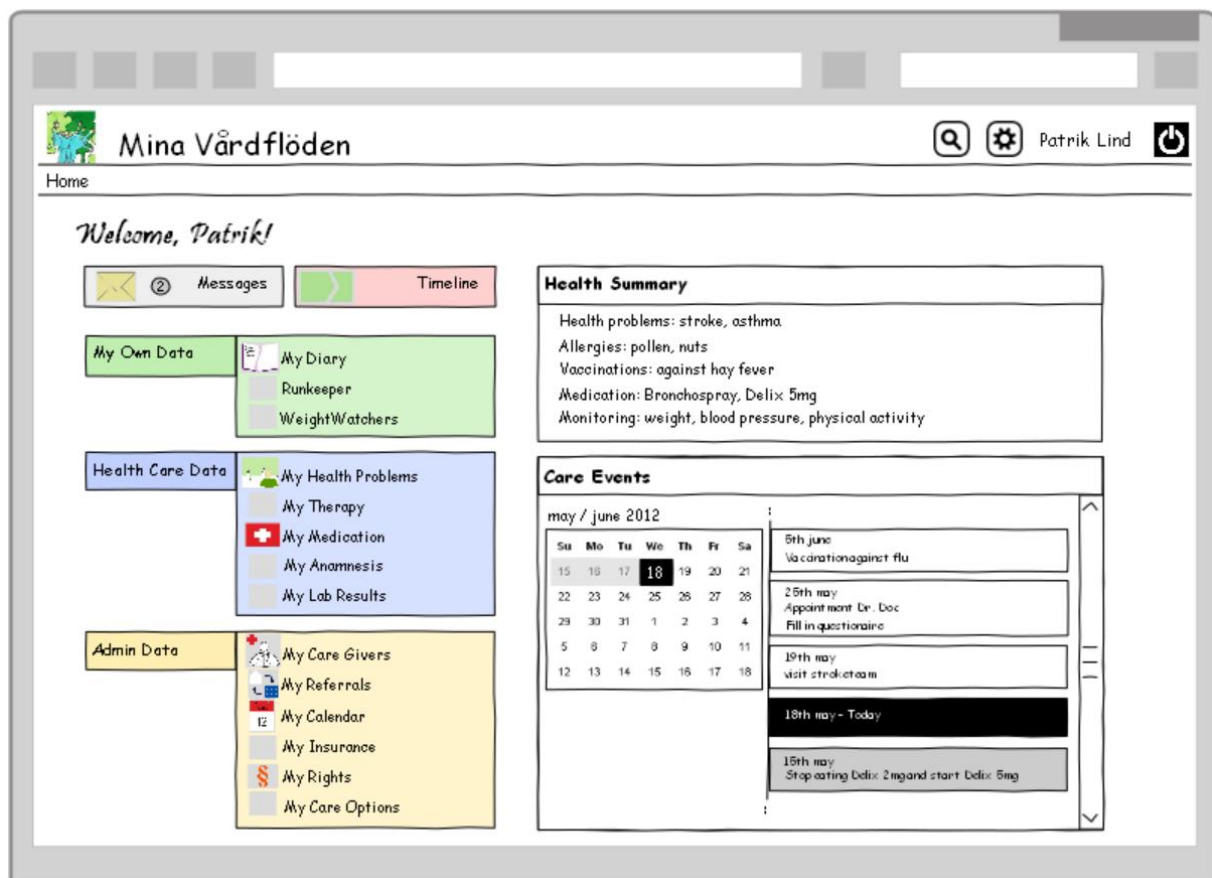
The alternative B (see figure 5.4(b)) combines a familiar calendar thumbnail with a timeline. Events lying in the past are highlighted in a different way than future events. Screen space is used more effectively than in alternative A, but the separation between administrative and health events is given up. In addition to scrolling there is another possibility to move in time: Clicking on a day in the calendar scrolls to the according time point.

The welcome screen gives a central starting point to the application and ties together all services. It is imaginable as a dashboard giving the user the choice to tailor it individually out of a collection of elements. The information delivered through the event timeline adapts to the information need at certain steps of the care process. The content of the health summary could be dynamic as well, giving information that is currently, at a certain time point, important for the patient.

Figure 5.3: Welcome screen



(a) Version A: care event in a timeline



(b) Version B: care events in a timeline with a calendar thumbnail

		
Messages	Timeline	My Diary
		
My Health Information	My Medication	My Care Givers
		
My Referrals	My Calendar	My Rights

Table 5.1: Service icons

My Diary

With a click on the *My Diary* button on the welcome screen the user gets to the diary view containing entries of today and a couple of last days (see figure 5.4). A click on the calendar icon in the upper left corner opens a calendar thumbnail allowing the user to jump to a certain date. The arrow buttons on the right and left to the day boxes allow scrolling through the days. There are three types of diary entries.

Text entry Free text with possible assigned subject and tags. The entry thumbnail contains the subject and the beginning of the text content. A feather was chosen as a symbol.

Attachment entry A file (e.g. in form of a picture or audio), uploaded from the own computers file system, with possible assigned subject and tags. The thumbnail contains the entry subject and the file name. The possibility of storing files in a time context, for example audio records, might help stroke patients who have hard times reconstructing previous conversations with care givers. A paperclip was chosen as a symbol.

Assessment entry A structured entry concerning the reporting or measurement of data by the patient. The thumbnail contains the parameter name and value. A curve graph was chosen as a symbol.

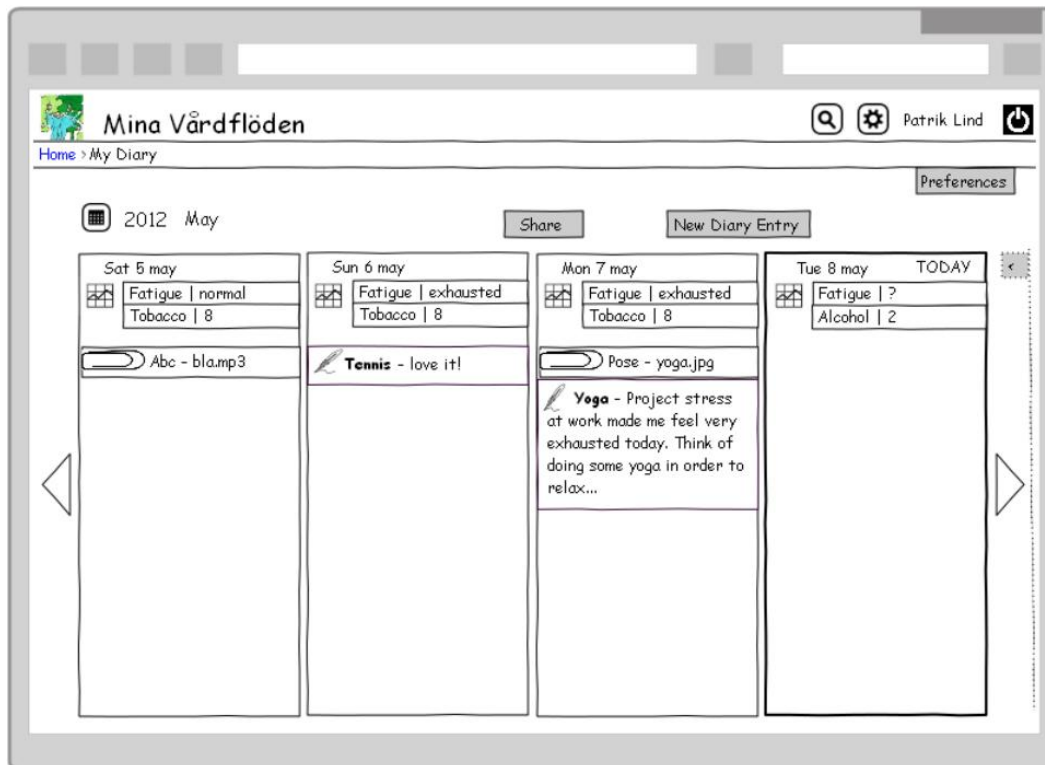


Figure 5.4: Diary: start view

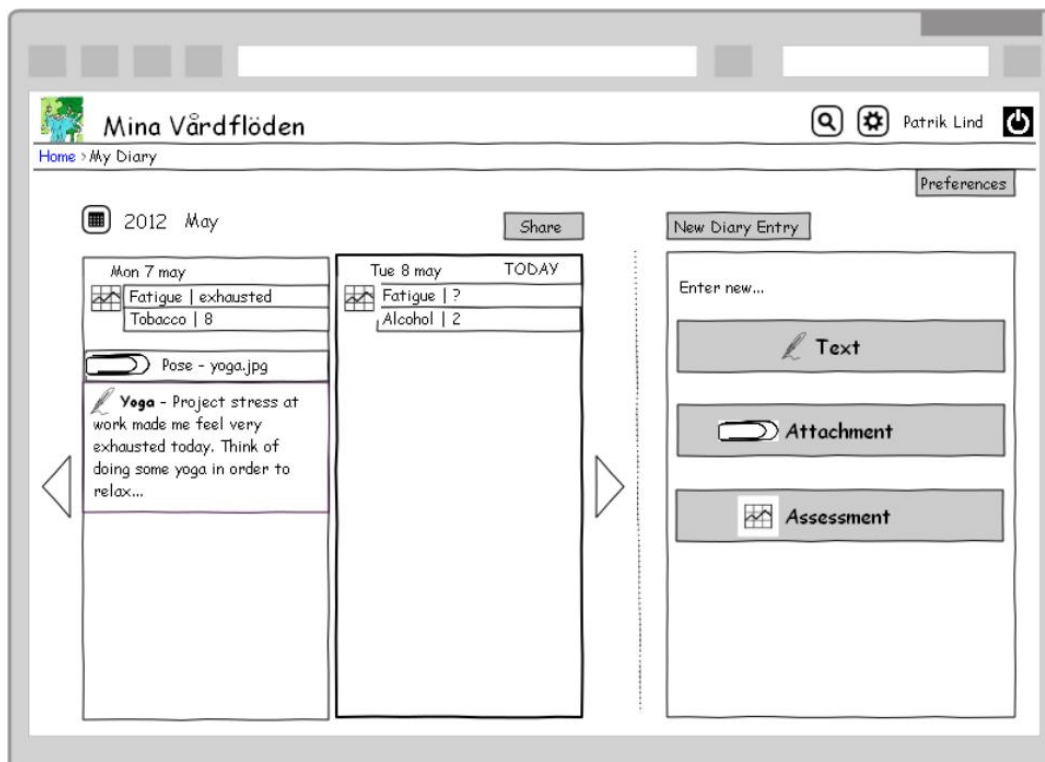


Figure 5.5: Diary: new entry

Figure 5.5 shows the view after a click on the *New Diary Entry* button. The number of shown days is reduced and a box containing the option of three entry types appears. Each button leads to an according form for the new entry. The new text entry form is shown in the right part of figure 5.6. Below a label and a symbol indicating the entry type *text*, there are form fields for the name (subject), date, time of the text entry, and a button allowing the deletion of the entry. There is a field for the text content and one for possible tags under it. At the bottom there is a *Save* button.

Figure 5.7 shows the form for a new attachment entry. It's similar to the text entry form; the only difference is that there is a field to add files instead of a text field.

Tags Text and attachment entries can be tagged with keywords in order to allow a classification which is useful for the data sharing. In the figures 5.6 and 5.7 there is a 'tag cloud' beneath the tags field showing all the tags that have been used before by the user. Tags can be assigned by clicking on an existing tag or by entering a new one. An automatic suggestion of fitting tags using contextual search on text entries or attached files is imaginable. Furthermore, tagging could be used as filter criteria on entries.

The screenshot displays a web application for a diary. The top navigation bar includes the site name 'Mina Vårdflöden', a user profile 'Patrik Lind', and a 'Preferences' button. The main interface is split into two panels. The left panel shows a calendar for May 2012 with two days visible: Monday, May 7th and Tuesday, May 8th. Monday's entry includes 'Fatigue | exhausted', 'Tobacco | 8', and an attachment 'Pose - yoga.jpg'. Tuesday's entry includes 'Fatigue | ?' and 'Alcohol | 2'. The right panel, titled 'New Diary Entry', contains a form for a 'New Text' entry. This form has input fields for 'Name', a date/time selector set to 'Tue 8 May' at '17:00', a large text area for the entry content, a 'Tags' field with a list of existing tags ('yoga tennis recipe vitaminC file'), and a 'Save' button at the bottom.

Figure 5.6: Diary: new text entry

Mina Vårdflöden Patrik Lind

Home > My Diary

2012 May

Mon 7 may

Fatigue exhausted
Tobacco 8

Pose - yoga.jpg

Yoga - Project stress at work made me feel very exhausted today. Think of doing some yoga in order to relax...

Tue 8 may TODAY

Fatigue ?
Alcohol 2

Share

New Diary Entry

New Attachment

Name < Tue 8 may > 17:00

Add File

Tags:

yoga tennis recipe vitaminC file

Save

Figure 5.7: Diary: new attachment entry

Mina Vårdflöden Patrik Lind

Home > My Diary

2012 May

Mon 7 may

Fatigue exhausted
Tobacco 8

Pose - yoga.jpg

Yoga - Project stress at work made me feel very exhausted today. Think of doing some yoga in order to relax...

Tue 8 may TODAY

Fatigue ?
Alcohol 2

Share

New Diary Entry

New Assessment

< Tue 8 may > 17:00

Choose...

Value

Unit

Time Unit

Save

Figure 5.8: Diary: new assessment entry

The assessment entry form is shown in figure 5.8. Common elements to the former two entry types are the date field, the time field, the *Delete* button and the *Save* button. Assessments are structured data from the beginning, and since they can be classified according their predefined names there is no need to assign them tags.

When creating a new assessment entry, only the drop-down list is visible and the user is supposed to choose a parameter from it. According to the chosen parameter, the other form fields appear, starting with a value field. For quantitative data this can be a text field allowing numerical values, for example. For qualitative data with predefined possible values the field would have the form of a drop-down list. For measurements, as blood pressure, there could be a button to import values from an external device. If the chosen parameter can be measured in different units an additional field appears. One of the predefined units would be selectable from a list. The same applies on the time unit if the unit is composed (cf. table 5.3 in section 5.2.2).

The form on the right does not only serve to create new diary entries but also to view and edit existing ones. Figure 5.9 shows the view that appears after clicking on a diary entry thumbnail: the according day and thumbnail are highlighted with a thicker frame, for example. The form on the right shows the entry in detail and changes can be done and saved. Figure 5.10 shows the details of an attachment entry. The file name and thumbnail are visible, which can be small presentation of an image file or even a player for audio or video files. Figure 5.11 shows the details of a text entry.

The screenshot shows a web application interface for 'Mina Vårdflöden'. The top navigation bar includes a home icon, the title 'Mina Vårdflöden', a search icon, a settings icon, the user name 'Patrik Lind', and a power icon. Below the navigation bar is a breadcrumb 'Home > My Diary' and a 'Preferences' button.

The main content area is divided into two columns. The left column shows a calendar for May 2012. The selected date is 'Mon 7 may', which is highlighted with a thicker border. Below the date, there is a list of entries: 'Fatigue | exhausted', 'Tobacco | 8', and 'Pose - yoga.jpg'. A text entry for 'Yoga' is also visible, describing a project stress at work. The right column shows a 'New Diary Entry' form. The form has a title 'New Diary Entry' and a 'Share' button. It contains fields for 'Assessment' (with a dropdown menu), 'Value' (with a text input field containing '8'), 'Unit' (with a dropdown menu containing 'cigarettes'), and 'Time Unit' (with a dropdown menu containing 'day'). There is also a 'Save' button at the bottom right of the form.

Figure 5.9: Diary: edit assessment entry

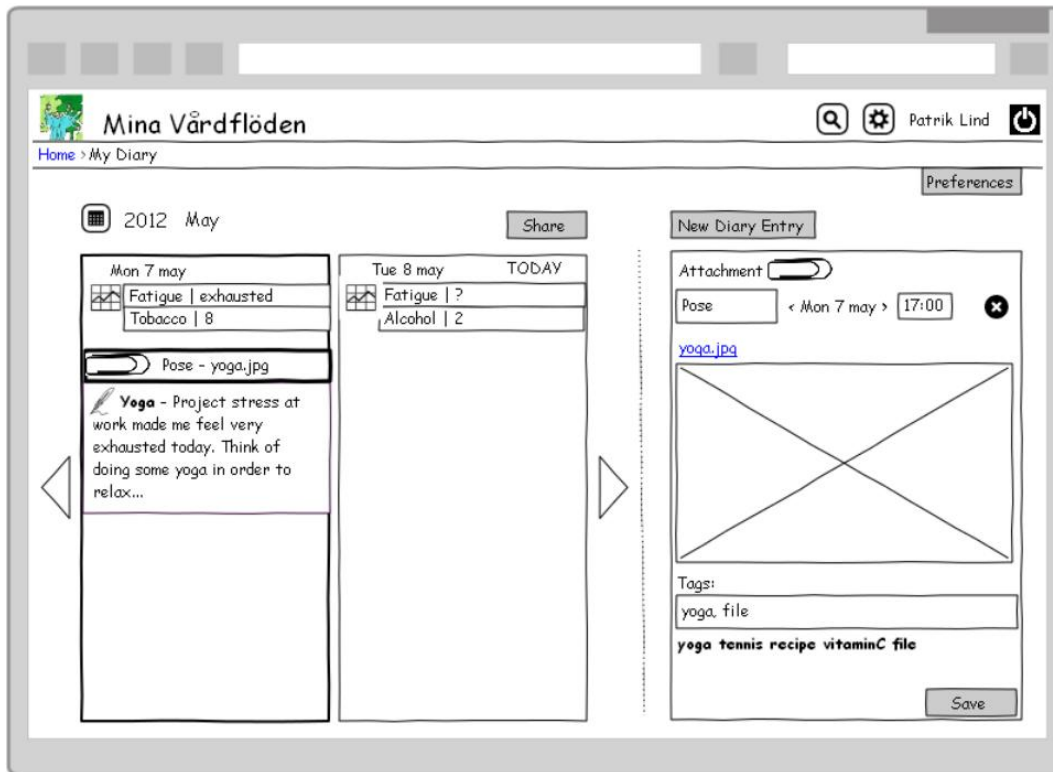


Figure 5.10: Diary: edit attachment entry

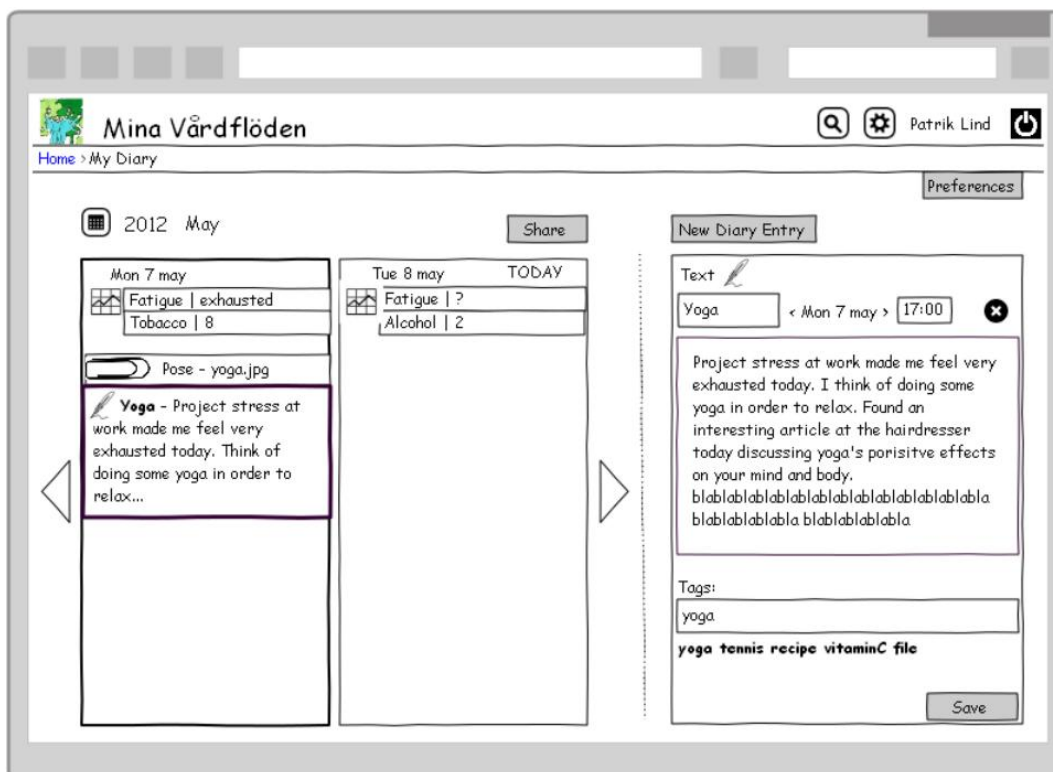


Figure 5.11: Diary: edit text entry

In the diary preferences shown in figure 5.12 the user has the possibility to set a time interval in which a parameter should be reported regularly, daily, weekly or monthly, for example. According this time interval empty diary entries are created reminding the user to be completed.

Mina Vårdflöden Patrik Lind

Home > My Diary > Preferences

My Diary Preferences

Text Entries Comic Sans MS 12 Text Color

Assessment Entries

- Blood Pressure
- Activity
- Physical Training
- Tobacco
- Fatigue
- Depression

Create New Parameter

Activity

Every day activity, like walking, biking or garden work.

Unit: hours

Time Unit: week

Regular Assessment

☐ none

☐ daily

☒ weekly Mo Tu We Th **Fr** Sa Su

☐ monthly Beginnig Middle End

Cancel OK

Figure 5.12: Diary: preferences

Selected Sharing of Diary Data

In order to share diary data with care givers the user can click on the *Share* button in the diary. Sharing data resembles writing an electronic message with a data package attached. That's why the view changes from *My Diary* to *Messages*. The appearing view (figure 5.13) shows the *Messages* interface in the background and a superposed window to select the diary entries to share.

The selection is effected in two steps. At first, the user has the possibility to set time and type criteria for the diary entry selection. Dates and timespans can be selected in the left box by clicking in the calendar thumbnail or by checking the checkbox to select the entire month.

The middle multiple selection list contains tags that ever were applied by the user to describe text and attachment entries. The first option '(none)' can be selected in order to select entries that are not tagged. Whereas this list is solely for text entries and attachment entries, the list on the right concerns the assessment entries. Here, the names of the reported and measured parameters can be selected.

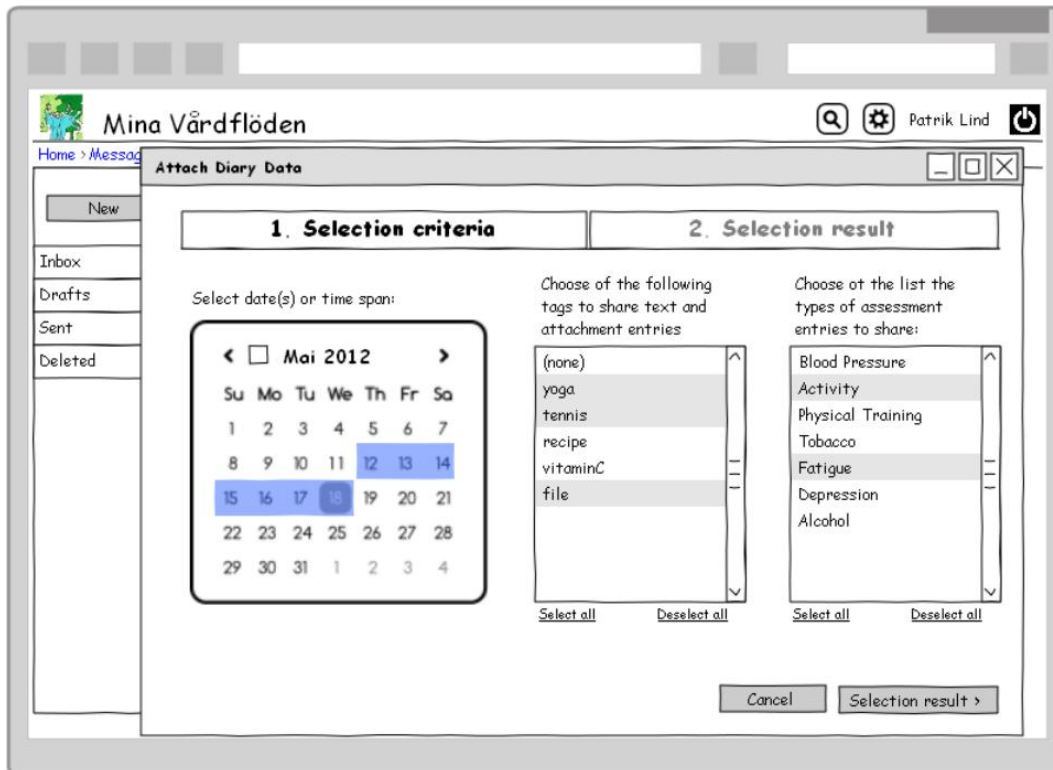


Figure 5.13: Sharing step 1: selection criteria

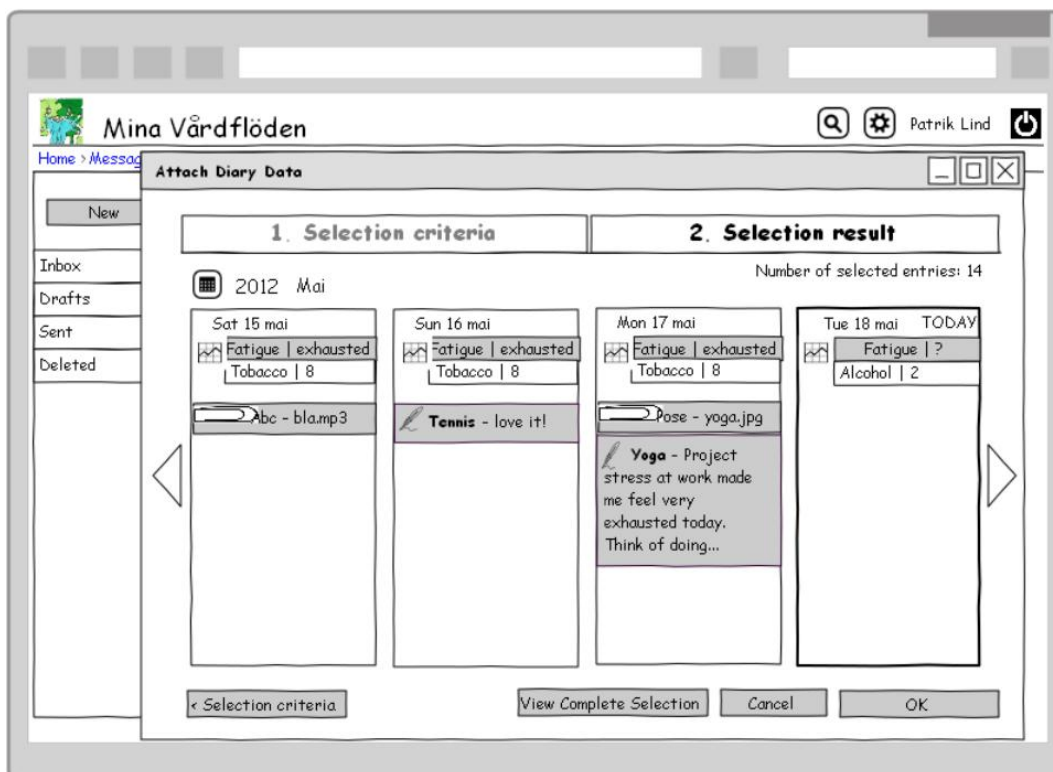


Figure 5.14: Sharing step 2: selection result

After setting the criteria and clicking on the *Selection result* button, the view changes as shown in figure 5.14. The design of the diary is picked up to show the selected entries matching the formerly set criteria, highlighted. The possibilities of navigation are the same as in the diary: the arrow buttons on the sides and the button on the upper left to open a calendar thumbnail.

The user is now able to select and deselect entries individually by clicking on the entry thumbnails. On the upper right, the number of currently selected entries is shown in order to give an overview of the possibly not all visible selected entries. One has the possibility to go back to the selection criteria by clicking on the button in the lower left corner *Selection criteria*.

A click on the button *View Complete Selection* opens a new browser tab to show all selected diary entries to share (see figure 5.15). This overview contains in the upper part the selected entries thumbnails ordered by date and below the complete entries ordered by type and date. The assessment entries are ordered by name and by date. The attachments are embedded in the page.

The motivation for this partly redundant overview is that on one hand the time relation between the entries is more easily visible through the thumbnails. On the other hand the reader might be interested in entries of a certain type or the assessment of a certain parameter and its development over time.

By clicking on the button *Generate pdf* in the upper right corner a pdf file is generated which can be printed out and taken to the doctor's appointment, for example. The printable pdf is based on the design shown in figure 5.15, but none printable attachments are left out.

If the user is in the sharing selection result view (figure 5.14) and clicks on *OK* s/he arrives at the message view shown in figure 5.16. The combined diary paperclip symbol indicates that there is content to share attached. There are the possibilities to view the selected entries (figure 5.15) by clicking on the symbol and to change selected entries (figure 5.14) by clicking on the button *Change Attached Data*.

The other buttons and fields have the functionalities one would expect from an ordinary e-mail program. Only the window for choosing the receiver has a particularity (see figure 5.17): the information about a possible receiver is quite detailed and in order to have another distinguishing feature a photo of the person is shown.

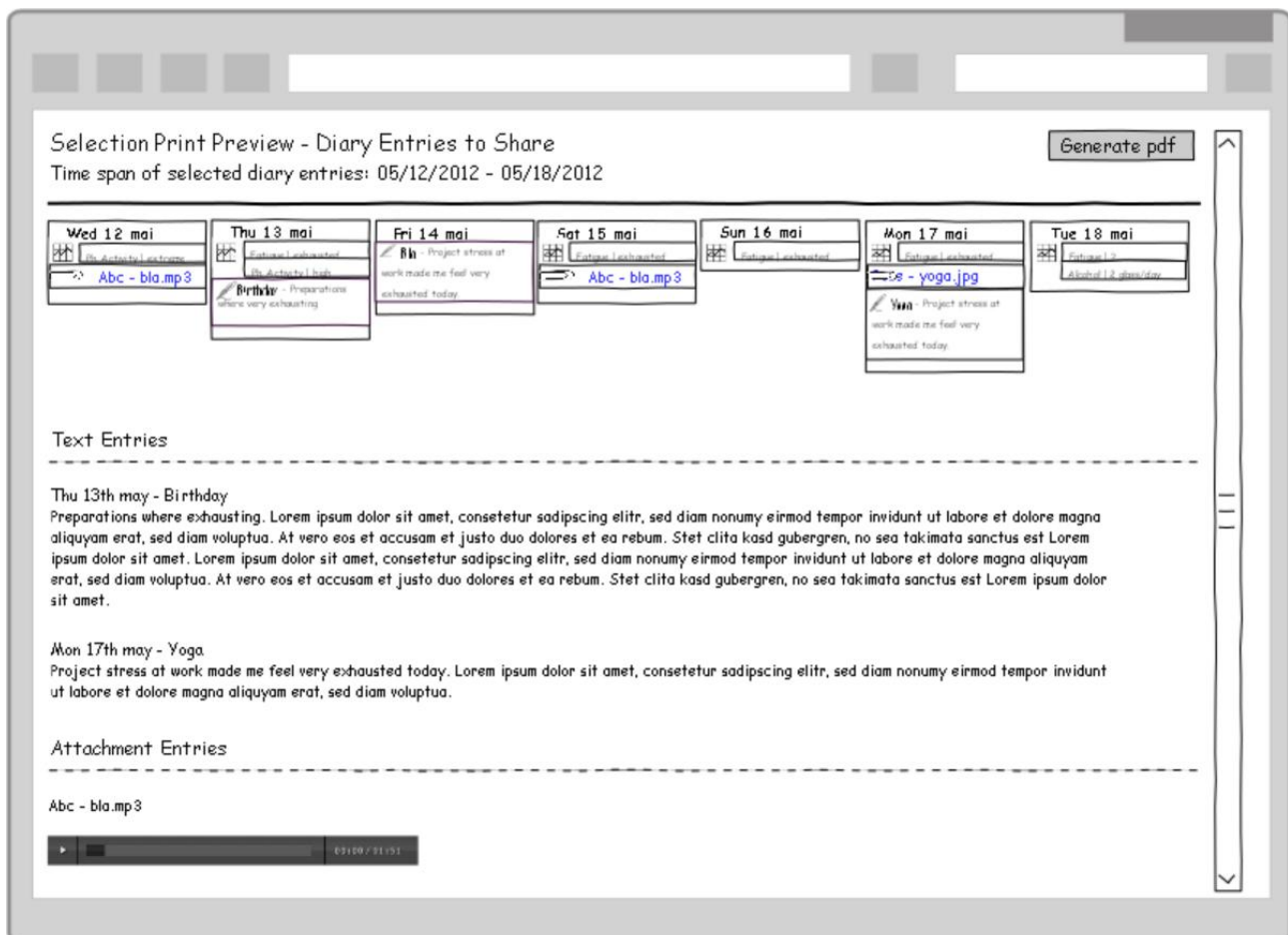


Figure 5.15: Sharing: overview of data to share

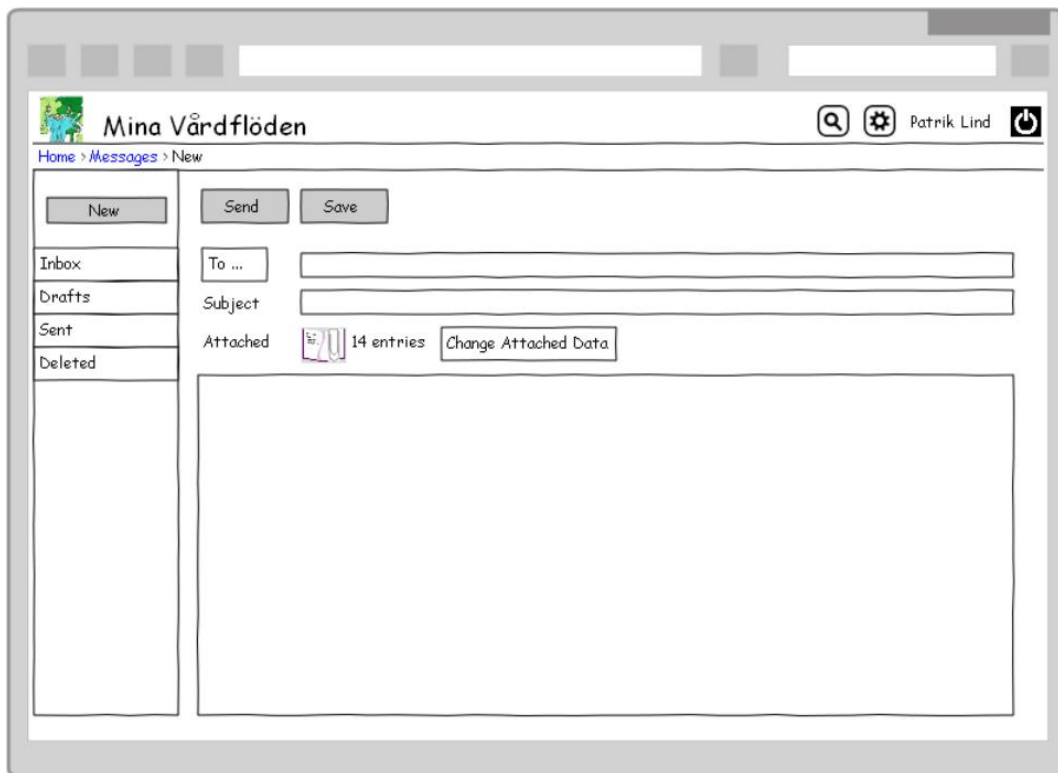


Figure 5.16: Messages: a message with attached sharing data

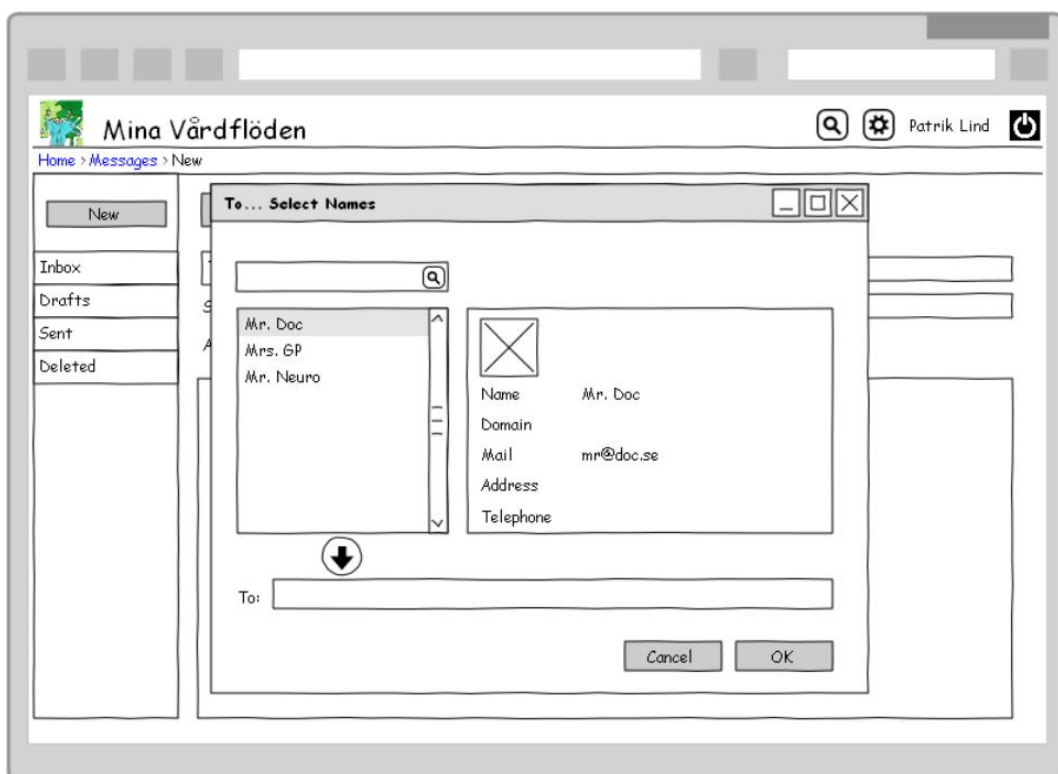


Figure 5.17: Messages: selection of the receiver

Timeline

The button *Timeline* on the welcome screen refers to a timeline giving an overview of the patient's care process, containing divers patient data collected from the first stroke to the current date (see figure 5.18).

At the top of the overview the entire time period is visible with time specifications in a certain granularity. There is a time selection bar superposed that enables the user to move in time by translating it and to zoom by adjusting its width at the draggable ends.

Below the time bar the respective places of stay are shown covering care process stages, as hospital, rehabilitation institution or home. A click on the stay opens the according time span. In this way, documents that were for example related to the discharge home can be found again. The time bar at the bottom covers the selected, visible time span and is directly related to the curves above.

The main frame in the middle contains visualizations of diverse continuous parameters and events of the different MVF services in rows. The user can find correlations between health parameters and implicit linkages, between events (appointment or those related to drug intake) and diary attachment entries, for example. The vertical detail bar displays detailed values for a certain date. It can be dragged and horizontally moved, and hidden.

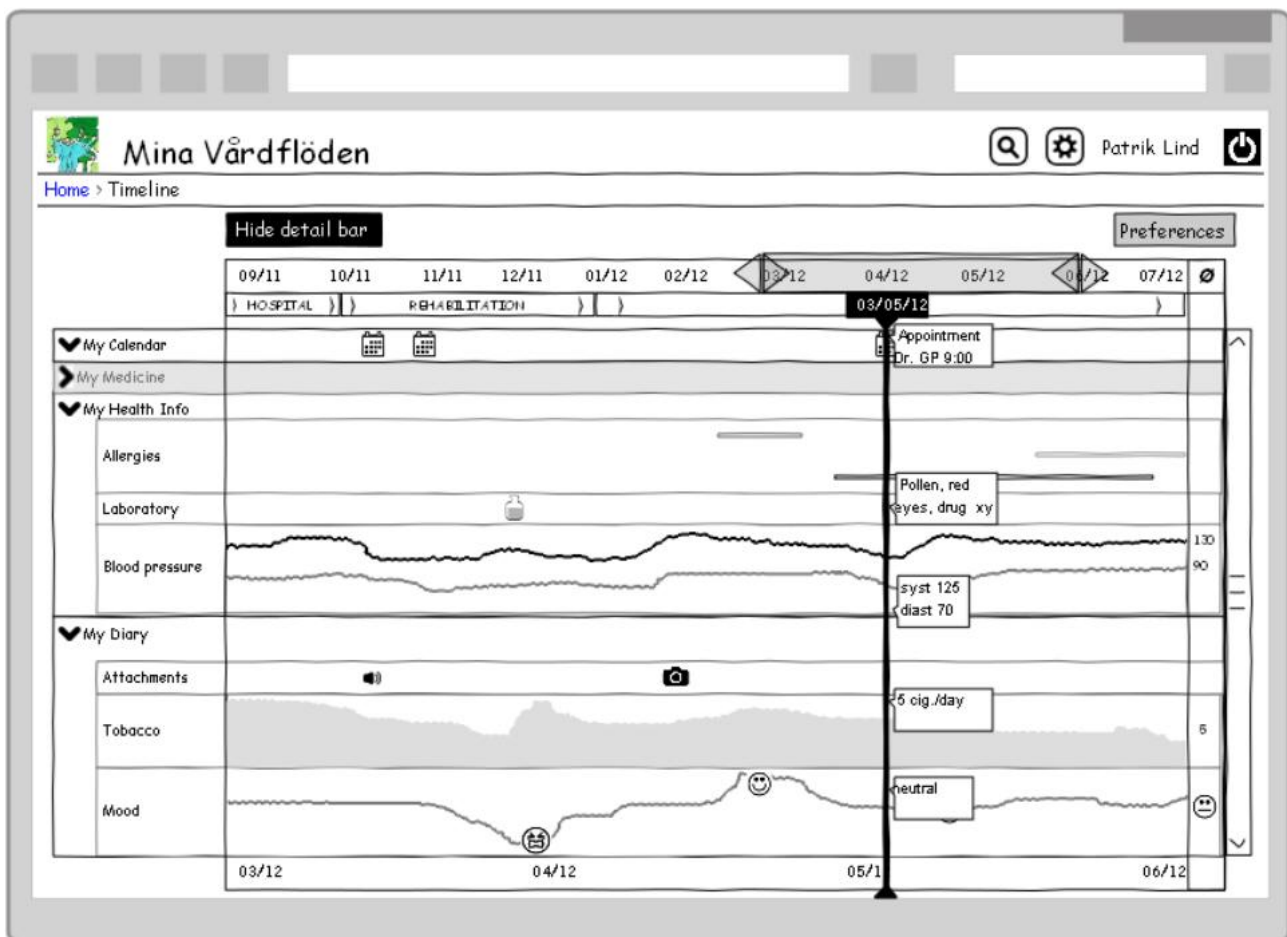


Figure 5.18: Timeline

Further detail-on-demand functions are necessary for two-dimensional data. For parameters changing over time an extra individual view providing higher resolution and zoom in the vertical measured quantity dimension is important. Furthermore, the timeline contents should be clickable and connected to the respective service to provide details on the parameters. During mouse-over, details can be displayed in a balloon as well. Mean values for the selected time span are displayed on the right side of the timeline. If the number of parameters exceeds the screen size a vertical scroll function is provided.

In order to customize the timeline the user can click on the *Preferences* button. In the upcoming view (figure 5.19) the user can choose which data should be visualized by filling the list of displayed data out of the left list containing all available data (by means of clicking on the arrow button). The parameters can be changed using drag and drop, and deleted (click on cross button). The order in the list determines the order in the timeline. So the user has the possibility to compare certain parameters by putting them one below the other.

The box at the bottom allows the user to change a parameter's visualization settings, like color and type. Other settings are imaginable, for example an option to display and hide concrete values.

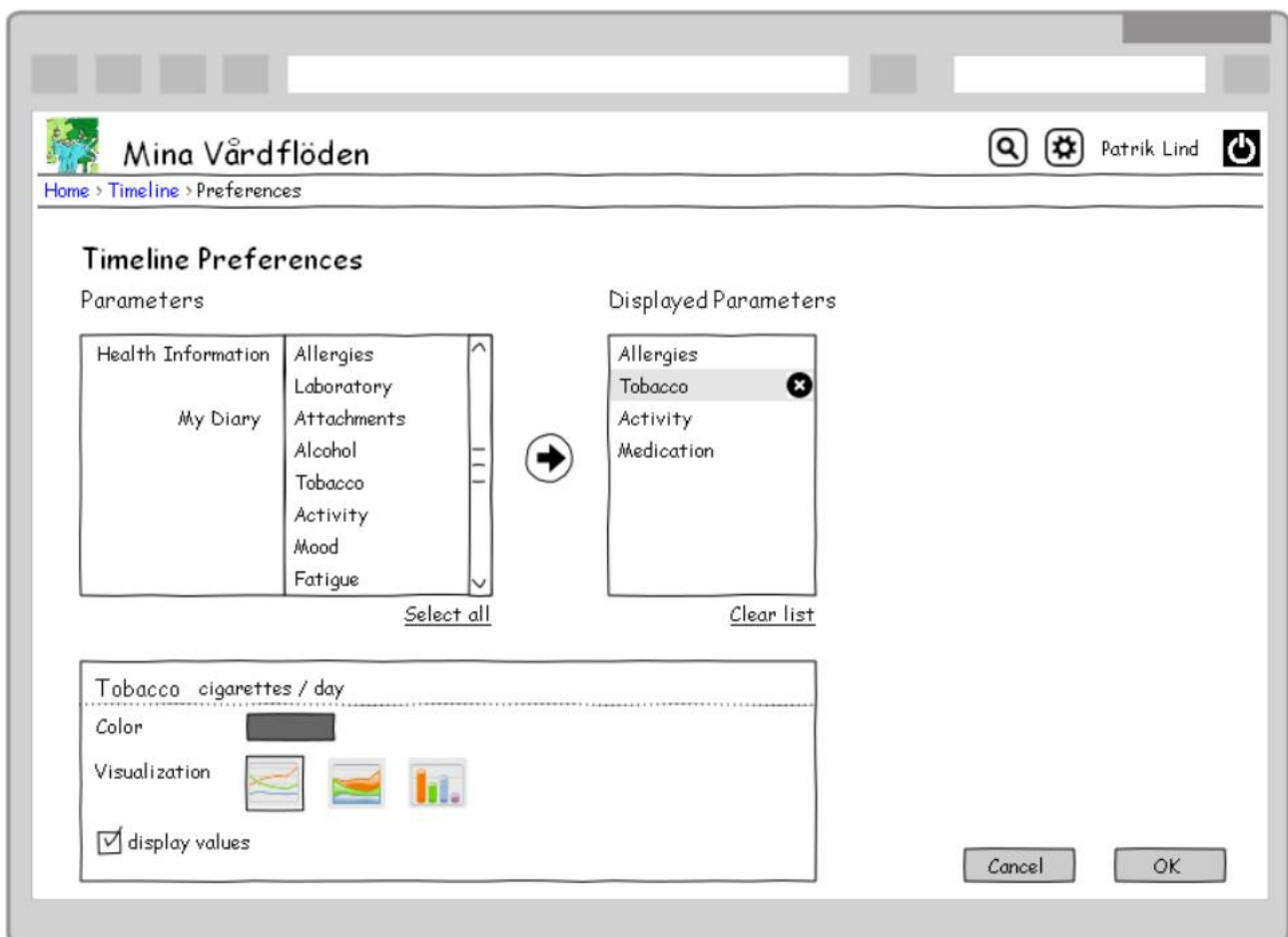


Figure 5.19: Timeline: preferences

5.1.3 Dynamic Prototype of the Diary

The dynamic diary prototype was implemented as a web application and is based on the static prototype (cf. figures 5.4-5.11 in section 5.1.2). The focus fell on the functionality, the program flow, and the basic layout. The look in terms of colors and fonts hasn't been thought through yet.

Starting the application in the browser, existing diary entries are loaded and displayed (see figure 5.20). With a click on an existing thumbnail dairy entry the details are shown in the entry form on the right (see figures 5.21, 5.22, 5.23). Existing entries can be edited and saved.

The upper right buttons *Share data* and *Preferences* are not assigned with functionality. A click leads to the opening of an information window.

With a click on *New Diary Entry* the user gets the choice of three types of diary entries: *Text*, *Attachment* or *Assessment* (figure 5.24). The interface changes depending on the clicked button to 5.25, 5.26, or 5.27. In the text and attachment entry form the user has the possibility to assign tags by clicking on items of the 'tag cloud' or by entering a new one in the *New...* field below the tag box.

Figure 5.22 additionally contains a legend of GUI elements.

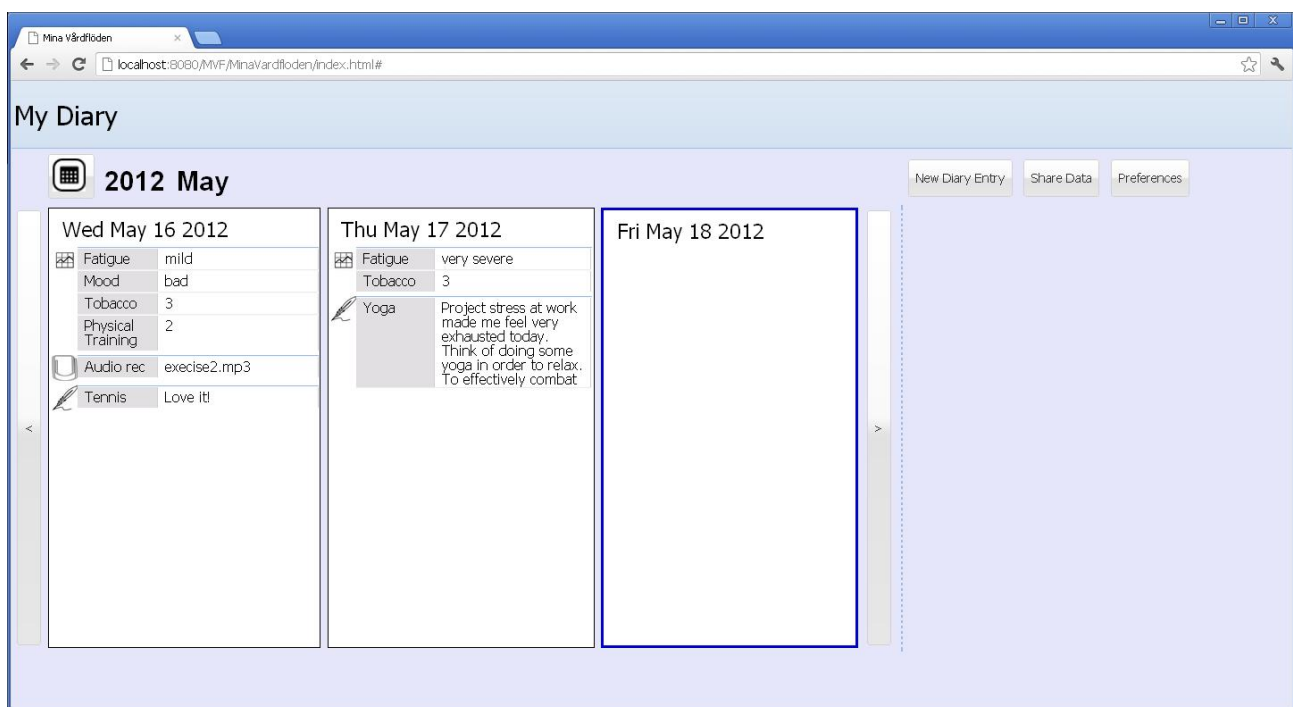


Figure 5.20: Diary: start screen (D0)

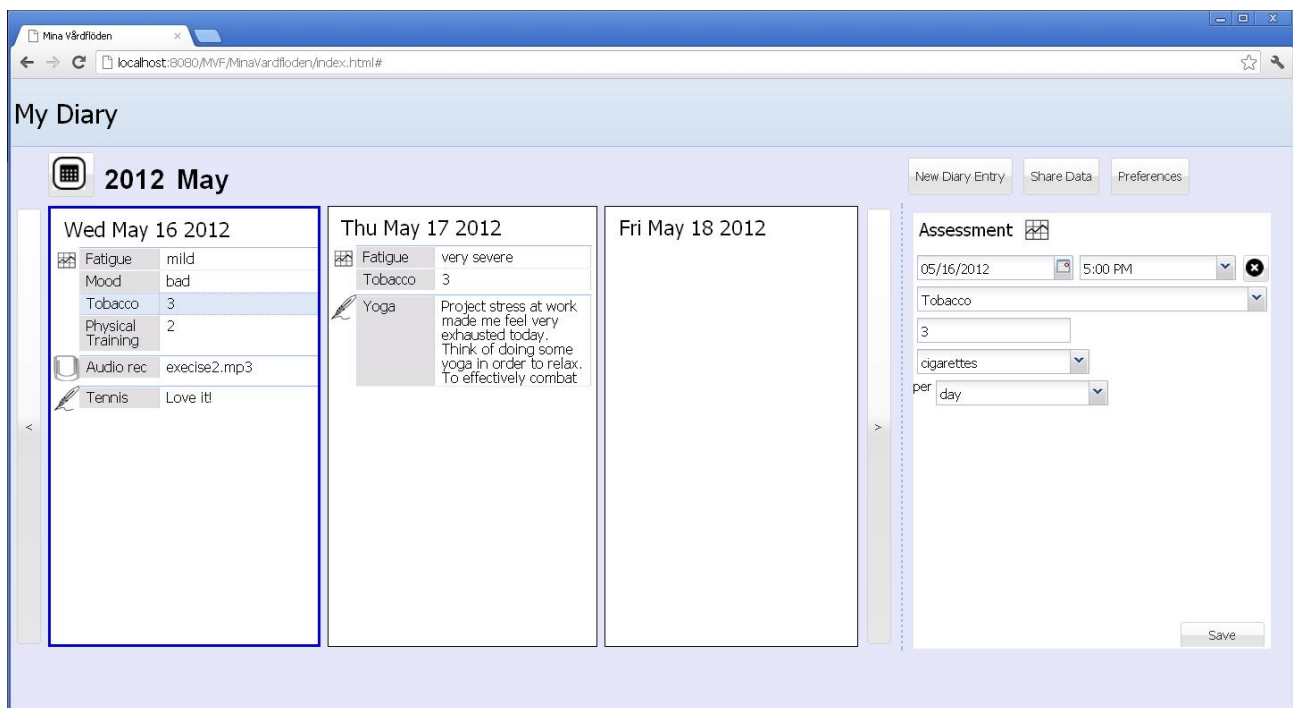


Figure 5.21: Diary: edit assessment (D1)

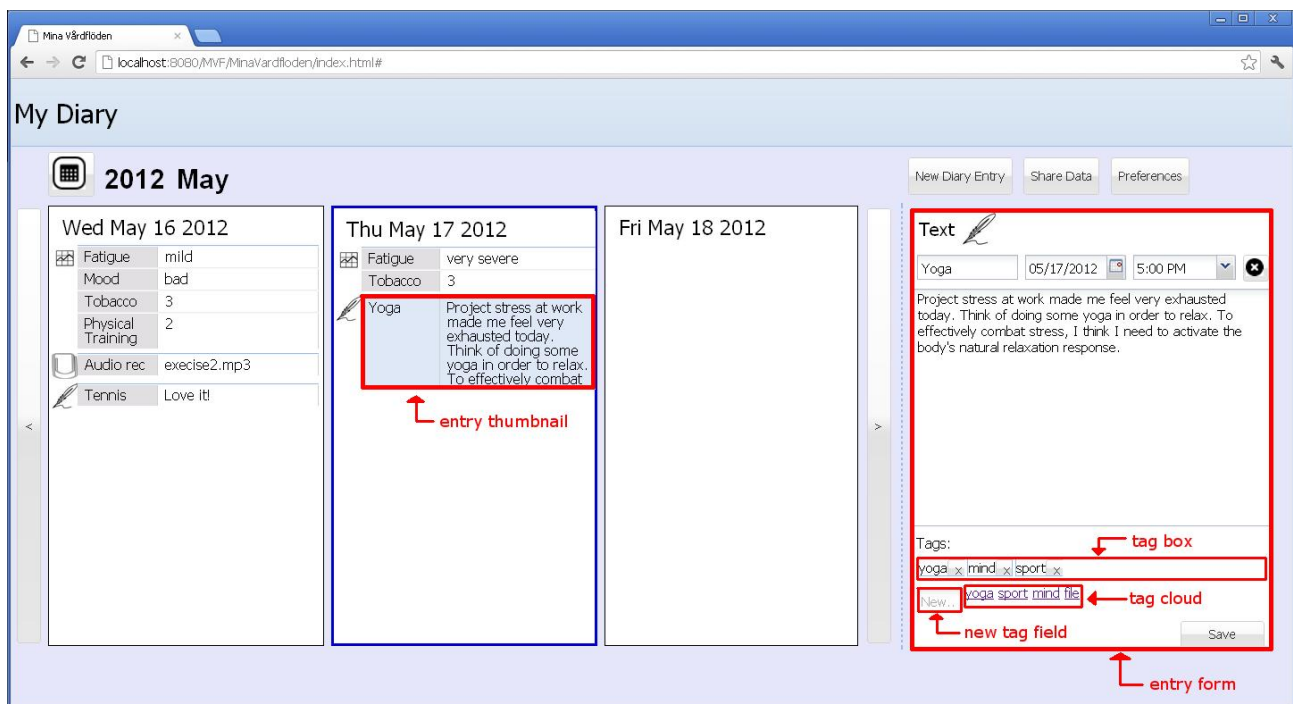


Figure 5.22: Diary: edit text (D2) with legend of GUI elements.

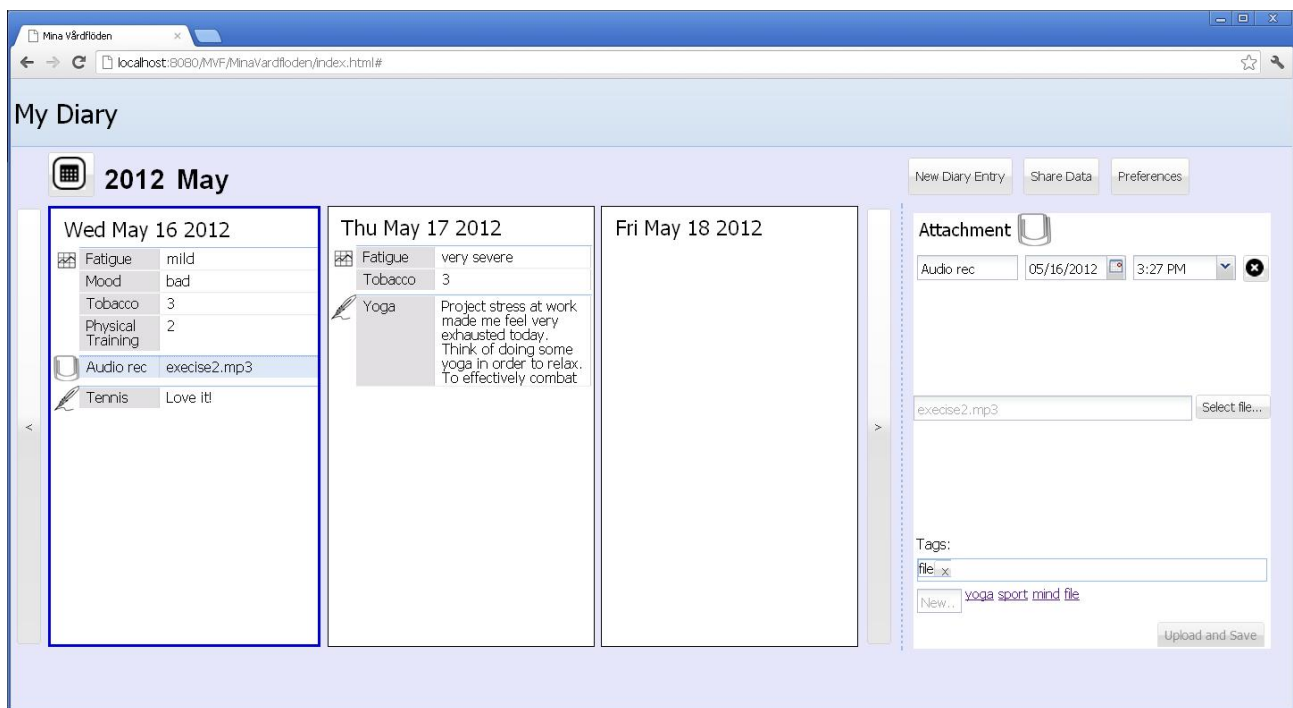


Figure 5.23: Diary: edit attachment (D3)

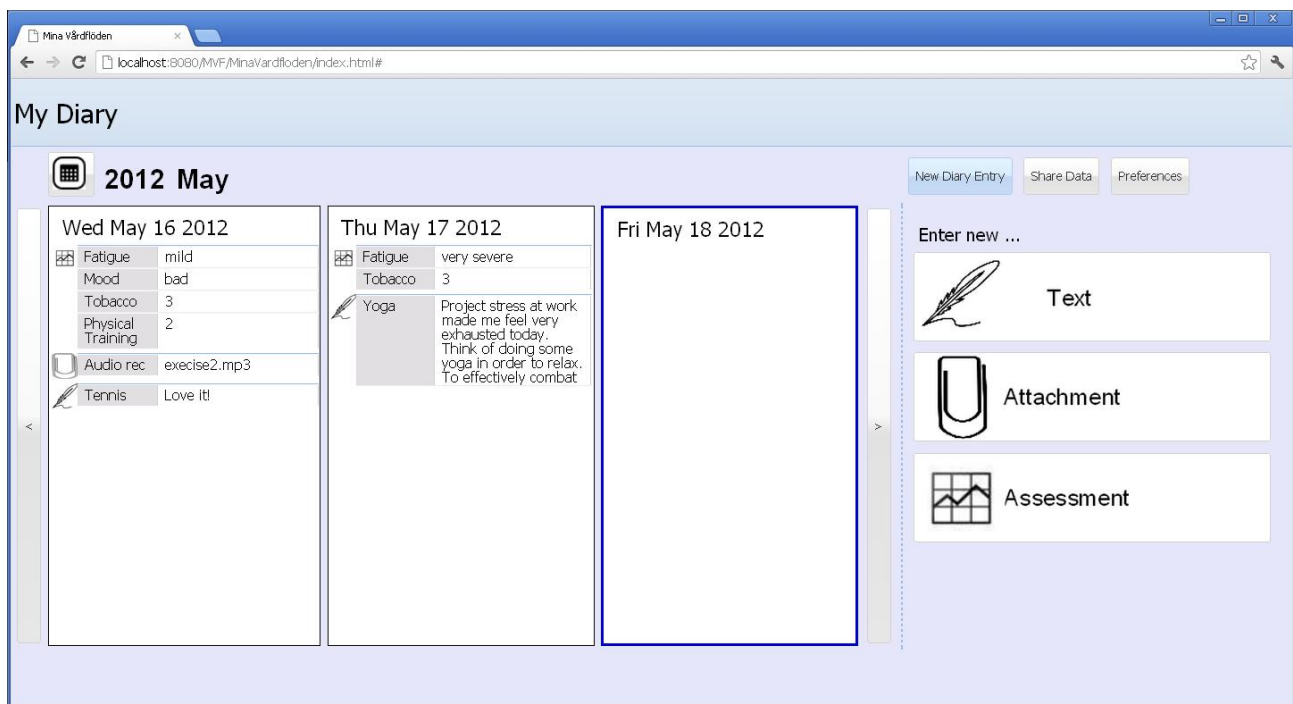


Figure 5.24: Diary: new entry (D4)

My Diary

2012 May

Wed May 16 2012

Fatigue	mild
Mood	bad
Tobacco	3
Physical Training	2
Audio rec	execise2.mp3
Tennis	Love it!

Thu May 17 2012

Fatigue	very severe
Tobacco	3
Yoga	Project stress at work made me feel very exhausted today. Think of doing some yoga in order to relax. To effectively combat

Fri May 18 2012

New Text

Subject... 05/18/2012 11:57 AM

Content...

Tags:

New... yoga sport mind file

Save

Figure 5.25: Diary: new text entry (D5)

My Diary

2012 May

Wed May 16 2012

Fatigue	mild
Mood	bad
Tobacco	3
Physical Training	2
Audio rec	execise2.mp3
Tennis	Love it!

Thu May 17 2012

Fatigue	very severe
Tobacco	3
Yoga	Project stress at work made me feel very exhausted today. Think of doing some yoga in order to relax. To effectively combat

Fri May 18 2012

New Attachment

Subject... 05/18/2012 11:55 AM

Select file...

Tags:

New... yoga sport mind file

Upload and Save

Figure 5.26: Diary: new attachment entry (D6)

My Diary

2012 May

Wed May 16 2012

Fatigue	mild
Mood	bad
Tobacco	3
Physical Training	2
Audio rec	exercise2.mp3
Tennis	Love it!

Thu May 17 2012

Fatigue	very severe
Tobacco	3
Yoga	Project stress at work made me feel very exhausted today. Think of doing some yoga in order to relax. To effectively combat

Fri May 18 2012

New Assessment

05/18/2012 11:33 AM

Choose name ...

- Blood Pressure
- Tobacco
- Alcohol
- Physical Training
- Physical Activity
- Pain
- Fatigue
- Mood

Save

Figure 5.27: Diary: new assessment entry (D7)

5.2 Theoretical Considerations

During the prototype development the characteristics of involved data were considered, as well as the health monitoring with the diary, and information sharing aspects.

5.2.1 Characteristics of Data involved in the Care Process

For the data the care process visualization was built on, the characteristics in table 5.2 were considered.

Blood pressure, for instance, is directly patient-, health- and time- related and can be measured and used both by the patient and the health care provider.

Dimension	Characteristics
Provider	Patient Health care provider Health care admin
User	Patient Health care provider Health care admin
Patient relation	Patient-related General
Data type	Quantitative Qualitative
Content	Medical/health-related Organizational/administrative
Time relation	Non time-related (static) Time-related: Continuously changing over time (2D) Events

Table 5.2: Different characteristics of care process data

5.2.2 Patient Self-Assessment in the Diary

The parameters which can be reported or measured in the diary prototype as so called assessment entries (see table 5.3) play a role in handling post-stroke effects or in the prophylaxis of a recurrent stroke. They contain blood pressure and a selection of observations of daily living as risk factors, as well as fatigue, pain and mood which play a role in aftereffects.

The ODLs are inspired by the Swedish self-assessment sheet for lifestyle habits [35] and have composed units where the time unit is the time interval for which the value is valid.

In search of pain scale the work of Benaim et al. [30] was considered. They tested the *Faces Pain Scale*

(FPS) in stroke patients and compared it to the *Visual Analog Scale* (VAS) and the *Verbal Rating Scale* (VRS). The FPS visualizes the degree of pain with faces and was considered for patients with language or cognitive disorders. But it was found that the faces rather represent sadness than pain and that it is hard to rank them in the correct order. Since the FPS's sole use is not recommended in stroke patients and verbal description scales have the best psychometric properties, the VRS is used in the prototype.

Different scales were found for fatigue [33] and mood [31] in stroke patients. All scales found contain many items to allow a complex assessment, are intended to be administered by a care provider, and aim to produce a best possible evaluation of the clinical pictures of fatigue respectively depression. However, the purpose of the short, regular self-assessment is to give the patients a possibility to monitor their constitution over time. That's why other simpler scales were chosen in the prototype. For fatigue the same predefined values were used as for pain. The mood scale was inspired by the *Smart Diary Suite*¹.

Parameter	Values	Unit	Time unit	Reference
Blood pressure	numerical values (systolic and diastolic)	mmHg	-	-
Tobacco	numerical	Cigarettes/snus*	Day/week	Levnadsvanor – självskattning [35]
Alcohol	numerical	Standard glasses**	Day/week	
Physical training	numerical	Minutes/hours	Day/week	
Every day activity	numerical	Minutes/hours	Day/week	
Pain	Predefined: None, mild, moderate, severe, very severe, worst possible	-	-	Verbal Rating Scale (VRS)
Fatigue	Predefined: None, mild, moderate, severe, very severe, worst possible	-	-	Verbal Rating Scale (VRS)
Mood	Predefined: Excellent, very good, good, neutral, not good, sad, depressed	-	-	Smart Diary Suite

* oral tobacco

** 50cl medium beer, 33cl strong beer, 12-15cl white or red wine, 8cl strong wine or 4cl sprit [35]

Table 5.3: Parameters for structured reporting and measurement in the diary (as so called assessment entries).

¹Link: www.sdiary.com (last accessed October 25, 2012)

5.2.3 Ways of Sharing Information

The motivation to communicate health information to care providers can result out of the patient's own initiative – which was considered in the static prototype – or out of a provider's request.

Asking the patient for information, for example to fill in a questionnaire, to answer on an appointment suggestion, or to do an observation over time, can be realized through structured templates.

Observation, questionnaire and appointment requests can be managed through the *Messages* service. A questionnaire bound to a fill-in date or an appointment can be linked to *My Calendar*. Observation requests containing time and information type could be integrated in *My Diary* as placeholder entries. At the date to share the information, for example before the next visit, a reminder can come up and a message with the diary entries to share can be prepared automatically.

5.3 Prototype Evaluation

The evaluation results are presented in two parts. The study participants who discussed the static and tested the dynamic prototype are hereafter denoted with 'P1' to 'P4' (cf. table 4.1 in section 4.3.3).

5.3.1 Static Prototype Evaluation

The results of the static prototype evaluation are presented in five sections. Four sections summarize comments according the research questions (RQ) (cf. section 1.2) and a fifth section summarizes further user needs.

RQ 1: Meaningful presentation of the data

The parts of the prototype which contributed most to the first research question are the welcome screen and the timeline.

The welcome screen was appreciated as a good starting point to the e-service.

"I think this whole page is good actually. If you get this page you see exactly where to go." (1)

Two persons agreed on the fact that the health summary box does not necessarily have to be on the welcome screen since not all information is always relevant.

"Most of these diagnoses are permanent. So it doesn't really have to be visible all the time. [...] But it would be really good to have a button, so you can check: 'what have they really diagnosed?' " (2)

"One thing that can be hidden is this about vaccinations, you only need to check sometimes – what did I get and what has expired?" (3)

Comparing the welcome screens A and B the opinions were balanced. P1 and P4 found version A with the simple vertical timeline to be clearer. P4 said that you could see more events at the same time and that there was no need for the calendar thumbnail because you could as well just scroll. The other two persons preferred version B with the calendar thumbnail since they were more used to that.

The suggestion of the moderator to make the welcome screen customizable – to add and remove things – provided agreement in two persons.

About the timeline and the little resolution in vertical value direction P4 found that parameters which are difficult to see should be displayable individually in detail.

In connection with the moderator’s statement that the timeline was created on the basis of data from different sources – the patient’s own data and the health care data – one person asked if you could tell a difference between who entered it. Another person stated that it was important to be able to reconstruct where which data comes from. Blood pressure, for instance, can be measured by different persons; and three people agreed that it made a difference if it was measured by the physician or at home due to the ‘white coat syndrome’.

RQ 2: Visualization to support the management of the individual care process

The health event box on the welcome screen and the timeline were perceived as useful to follow the own care process.

”[...] this page *Health Events* – a very good little image. Nice and clear, and you know exactly. Then you can send in a note in advance, or fill something out. Really good. I can see when one medication is out, and when a new begins. Dates when it starts and ends. A really good little box.” (4)

In the timeline, P3 complimented the possibility of changing the time resolution so that you could look at a whole month or just the last week, for example.

RQ 3: GUI to support health monitoring

Diary and timeline were found to be well suited to monitor the individual health.

The possibility to look up notes at a later date was recognized as a benefit of the diary. Two persons stated that it was important to directly document how you feel, since you might forget about it till the next doctor’s appointment.

”Yes, what’s important is that you write what you feel at the moment, because later when you get to the doctor you might not remember it.” (5)

Nevertheless, two persons had some objections about the actual use of such a diary. They said that they would not use it daily, but maybe weekly.

The idea of visualizing diary data together with other parameters in the timeline was well received. P3 found that with the timeline you could find out the reasons for your mental or physical state by looking at the big picture of influences.

”[...] That you have something here that you can relate to, what was it that made me feel good or bad? Well, I had three beers that day, that’s why my values were so low the day after.” (6)

The mean value indicator on the right side of the curves was appreciated by two persons. Furthermore, P3 stated that it would helpful to get reference values, the optimal blood pressure value, for example.

RQ 4: GUI to support selected data sharing

Even though in the beginning the sharing view was confused with the diary, the reactions were positive.

”I think it’s good that you can share everything, and then it’s up to each person to decide what they want to share. And before I send it out I can change my mind when I see what it is that is actually sent.” (7)

Regarding the selection of the diary data one person stated that the selection via time and type criteria wasn’t complicated. Nevertheless, several questions about the sudden interface change from *My Diary* to *Messages* hinted confusion.

In a discussion about the care provider’s rights the moderator stressed that it should not be possible for them to log into the patient’s MVF account. P3 found that this was why the messaging and sharing functions were so important.

Relating to the sharing selection result view one person asked if it was possible to open the full diary entries in order to make sure you were sharing the right things.

Besides the sharing of diary data the issue came up to share data to support the anamnesis. The moderator asked if the participants would like to be able to print a health summary to bring it to the physician. One person agreed on the fact that such a health summary could be useful in order to replace an oral patient’s report at a first appointment with a new provider.

Further user needs

During the discussion further information and function needs came up.

On the question of which information would be of most interest on the welcome screen two persons agreed on reminders of appointments. One person also stated that he would like some commercial for certain health care centers related to his conditions.

”So, what I would like to see most are prescriptions and referrals. And the appointments.”
(8)

When the moderator asked which measurements were important for the patients to see over time P1 and P3 stated that it depended and that for diabetic patients blood sugar and blood pressure were important.

Further issues that came up were the need of an understandable presentation and interpretation of laboratory results and integration with other data, and explanations about different units for blood sugar measurement, for example.

While talking about appointment reminder functions two persons stated that they would appreciate a reminder per SMS to the mobile phone.

One person asked for a search function on the welcome screen and the idea came up to add a list of personal links of interest, for example to patient forums.

5.3.2 Dynamic Prototype Evaluation

The results of the data collected about the dynamic diary prototype are presented as four main usability problems (see tables 5.4 to 5.7). For each problem the tasks where it occurred, the number of user that encountered it, a description and accompanying extracts from the transcript are given.

In the transcript extracts the users' statements are in italic. The observer is denoted with 'O'. The square brackets contain author's comments and bold square brackets author's comments about unexpected behavior. The transcripts contain references to views of the application (cf. section 5.1.3). The tilde (~) indicates that the view is not exactly identical, but that small things can differ, form field contents, for example.

This section contains furthermore a summary of the written questionnaire (see table 5.8) and the debriefing questions (see table 5.9) given in the cooperative evaluation session.

The GUI elements referred to in the evaluation are indicated in the legend of figure 5.22 in section 5.1.3.

Problem	Confusion with the entry <i>Delete</i> button
Related to task	A, F, D
Numbers of users encountering the problem	3 out of 4
Description	<p>The <i>Delete</i> button is in the upper right corner of the entry form and has no label but a picture showing a cross.</p> <p>In two cases (task A) this button was taken for a <i>Close</i> button. The user's intention was to close the entry form. In another case (task F) this button was taken for a button to delete a tag. When the task was actually to delete an entry (task D), three persons had problems to find the <i>Delete</i> button.</p>
Transcript Extract	<p>[P4 completed the task A. (view D2)] [P4 moves the mouse on the Delete button.] P4: <i>Here I can close it, or?</i> [P4 reads the tooltip "Delete entry".] P4: <i>No, maybe it's not that, I should not delete it.</i></p> <p>[P1 wants to perform task F] [P1 clicks on the entry thumbnail. (view changes from to ~D5 to ~D2)] [P1 clicks on Delete button of the entry form.]</p>

Table 5.4: Usability problem 1: Confusion with the entry *Delete* button

Problem	Issues about saving an entry
Related to task	C, E
Numbers of users encountering the problem	2 out of 4
Description	There were two issues about saving a diary entry. In two cases the saving was missed after editing an entry. In another case the user was confused since the entry form did not disappear after pressing the <i>Save</i> button.
Transcript Extract	[P3 completed task C but he doesn't seem satisfied.] O: What are you thinking? P3: <i>It's laying here [he points the mouse on the entry thumbnail] but it does not disappear here [he points on the entry form].</i>

Table 5.5: Usability problem 2: Issues about saving an entry

Problem	Wrong entry type
Related to task	B
Numbers of users encountering the problem	3 out of 4
Description	In task B the users were expected to click on <i>New Entry</i> and following in the frame with the three entry type options, on <i>Assessment</i> . All users had difficulties to create an assessment entry. Instead, three of them created a text entry and entered the information of 'severe fatigue' in the subject and content text fields.
Transcript Extract	[P3 clicks on <i>New entry</i> . (view changes from D1 to D4)] [P3 clicks on Text instead of Assessment. (view changes to D5)] P3: <i>Can you search for tags down here? [P3 clicks in the tag box.]</i> [After a while P3 clicks on an existing fatigue entry and changes date and value in the upcoming form according to the task.]

Table 5.6: Usability problem 3: Wrong entry type

Problem	Issues about creating an entry tag
Related to task	E
Numbers of users encountering the problem	4 out of 4
Description	Task E included the creation of a text entry and the creation of a tag. This is possible by typing in the <i>New...</i> field under the tag box and clicking <i>Enter</i> . Two persons did not find the field to create a new tag but clicked on the <i>Tags:</i> label or in the tag box. The other two persons found the field and entered the name of the new tag but did not press <i>Enter</i> to save it.
Transcript Extract	[P1 clicks on <i>New entry</i> and on <i>Text</i> . (view changes to D5)] [P1 enters subject and content.] [P1 clicks next to the label Tags: and types 'drug'.] P1: <i>Nothing happened... should I put it there?</i> [points on the <i>New...</i> field but then clicks in the tag box.]
	[P2 clicks on <i>New entry</i> (view changes from D0 to D4) on <i>Text</i> . (view changes to D5)] [P2 clicks on the Tags: label and in the tag box.] [View does not change.] P2: <i>Then I don't know how to create the tags.</i>

Table 5.7: Usability problem 4: Issues about creating an entry tag

Question	Summarized Answers
Do you write a blog?	None of the participants writes a blog.
Do you write a diary? If yes, with which tools? (paper and pen, program, others)	One person (P4) writes a diary with paper and pencil.
Do you monitor health/daily life data (e.g. physical activity)? If yes, which ones?	One person (P2) monitors his blood pressure.
Do you think such diary functionality would be useful for you?	P1 and P4 answered yes, P2 answered yes with some training and P3 said that he would use it to some extend.
Would you rather enter the diary entries via writing or via speech (recognition)?	Three persons prefer writing and P3 would do both.
Which would be your preferred devices for the use of Mina vårdflöden? Computer, smartphone or tablet? If you would use several devices, please give a preference order 1(most preferred device) to 3	P1 and P4 would use the computer. P2 would use smartphone and tablet. P3 would use (1) computer, (2) smartphone and (3) tablet.

Table 5.8: Written questionnaire and summarized answers

Question	Summarized Answers
What was the most difficult task?	Task E with the creation of a tag was found to be most difficult one.
How did you like the diary program?	They liked the diary and thought that it was quite easy to use above all after getting used to it.
What would you improve? Do you have any recommendations for us?	Two persons would change the font style. P3 explained that the most readable font styles for stroke patients are <i>Garamond</i> and <i>Palatino</i> . Also it should have more vibrant colors.

Table 5.9: Debriefing questions and summarized answers

Chapter 6

Discussion

The objectives of this work, to prototype a patient e-service's user interface and to evaluate its usefulness and usability with representative users, were achieved.

The evaluation showed that the study participants could identify with the prototypes. They established parallels to their own lives and appreciated the development of a service meeting their needs. This affirms the benefit of the method of scenario-based design.

The focus group discussion showed that all designed functionalities and the graphical realization are perceived as useful to support stroke patients in the management of their care process.

The participants' positive reactions to the timeline and welcome screen showed that the prototype answers research question 1 (cf. section 1.2), of how to present data in a meaningful way.

The evaluation showed that the health event box on the welcome screen, and the timeline contribute to research question 2, since they were received as helpful features to follow and manage the care process over time.

The diary and the timeline prototypes answer research question 3, on how to support patients in monitoring their health. The participants especially appreciated the graphical presentation over time and the possibility to share data with doctors.

The sharing functionality answers research question 4 about selected sharing. However, questions of stroke patients during the focus group discussion revealed a lack of clarity in the user interface.

The work on the dynamic prototype helped to get a clearer picture of the diary to support patients in monitoring their health, and so contributed to research question 3. Low-level aspects, as the differentiation of diary entry types were examined.

The usability testing of the diary revealed four main problems which could be addressed by the reorganization of GUI elements and by user help and training.

6.1 Discussion of the methods

The static prototype and the focus group discussion were most suited to answer the research questions. Nevertheless, the dynamic diary prototype and its testing through cooperative evaluation brought valuable usability feedback about details that are not visible on the first sight on static prototypes, but are crucial for the final success and usage of the application.

The focus group discussion on the basis of the prototype presentation was suitable and the group of three participants was not too small, but had a good size, also to address everybody's questions.

In the usability testing method of *Cooperative Evaluation* there is a risk of manipulating the test person. In its pure form of *Think Aloud* this risk is limited since the observer is not allowed to talk. We tried to minimize the manipulation by not directly answering the test person's questions and could benefit from the dialogue situation to get a higher insight in the participants thought process.

A critical point regarding the evaluation is that the study participants with an average age of 71,5 were older than the stroke patient persona Patrik of 42 years on whose scenarios the prototypes were based on. Despite this discrepancy the results are valuable, since the participants all had at least basic computer experience.

6.2 Comparison with existing visualizations

A difference noticed in comparing the views of the tools named in section 3.2 is that the EHR systems [22, 23, 32] aim to provide the care giver with broad overviews whereas the PHR systems *WebMD*, *My HealthVet* [25], *Health Manager*, and *My HealthInfo* true give visualizations of tracked information, but rather for one parameter at once.

As the feedback to the timeline prototype shows, overview functions are as important for PHR systems, especially for chronic conditions which involve a lot of information. The overview visualization techniques are similar for EHRs and PHRs nonetheless regarding Shneiderman's "Visual Information Seeking Mantra" [34]:

"Overview first, zoom and filter, then details-on-demand"

The health event timeline on the welcome screen was perceived as very useful for patients, but would have no use in EHR systems. The indication of their places of stay in the timeline helps patients to better understand the care process, as well.

Whereas in EHR systems demographic information and a patient photo are useful [32, 22], it is not needed in PHR systems unless several individuals, for instance family members, are managed by one user.

The user interfaces of the EHR systems [32] and [22] contain a medical problem list, but it can be counterproductive in PHR systems. For self-ascertainment or for sharing with a doctor it can be useful, but it should not be displayed by default.

The sharing functionalities found in existing PHR systems differ a lot. *My HealthVet* [25] provides a feature – realized by means of one button on the user interface – to get a digital, printable

output of the own health information which can be shared with care providers. *HealthVault* facilitates a selected sharing; the user may choose care provider and data types. The selection by time or of individual items was not seen in the existing tools. However, the possibility to exactly choose what to share – in the presented prototype realized for patient’s own documentation and monitoring – was perceived as useful.

Particular attention should be paid to the readability in PHR systems. Font style, contrast and colors should be customizable in order to adapt to patients’ sight disorders. A feature demanded for PHR systems is the comparison of the patient’s individual measurements to reference values.

Chapter 7

Conclusion and Future Work

The top-down approach from static prototypes with larger scope to dynamic prototypes with deeper functionality was good to keep in mind the 'big picture' of the e-service and its interconnected sub-services.

Low-fidelity prototypes are not as time consuming and even sophisticated visualizations can be envisioned quickly to communicate the idea. They were a good means for verifying assumptions about the users, and the usefulness of the planned functions.

However, the development and evaluation of a functional prototype bring additional feedback to find out, if the envisioned functions are not only useful, but also usable.

The developed prototypes represent an important step in the design of the e-service *Mina vårdflöden* and can be seen as functional requirements with visualization recommendations.

However, further work has to be done to finish the scenario-based design life cycle (cf. section 4.1); to name specifications in terms of use cases, and to supplement the design language with an appealing look-and-feel.

Further work needs to be done on the user interface design for other devices, as smartphones and tablet computers.

As a conclusion I can say that the developed prototypes represent a suitable graphical user interface and visualizations to support stroke patients in the management of their care process. An overview of appointments on the start screen, a diary to document and monitor health, a timeline overview of all time-related health information and a selected sharing functionality were found to be important features of a personal health system for stroke patients.

Appendix A

Scenarios

A.1 Conceptual Scenario

Before the next visit or when I feel worse

The scenario describes a patient who is either preparing for a return visit to the primary care physician, or wanting to handle a deteriorating health condition.

Rationale The scenario is used in the project *Mina vårdflöden* to describe situations of use of the proposed services for stroke patients. The scenario will be part of a scenario corpus, and used to communicate the needs and context description to the development team and also as a basis for discussion at patient group meetings to concretize issues concerning security, privacy, value(?), and service development.

PAKT analysis	
Persons	Stroke patient <i>Patrik</i> and his family doctor <i>Hans</i>
Activities	Regularly documenting how he is. Being able to see the context in his own health documentation. Being able to share his own documentation with his health care providers.
Context	At Patrik's home, at the health care centre, and in the bus
Technique	Laptop with internet connection or smartphone — access to the e-services <i>My Diary</i> , <i>My Medicine</i> , <i>My Care Providers</i> Computer connected to the health care center — operating system for the primary care physician who can see information from <i>My Diary</i> Smartphone — <i>My Calendar</i> app

PART 1 Patrik had a stroke three years ago and has recovered fairly well. He has returned to work part time but still suffers from fatigue and concentration difficulty. The first year after the stroke, he underwent a deep depression and in the process of recovering, he discovered how important it is for him to find a stable and healthy lifestyle. With the help of the service *My Diary* Patrik books self-care/rehabilitation, physical exercise, diet, and subjective assessments of how he is doing every day. This tool has given him insight into how his lifestyle affected his wellbeing. In addition, Patrik

can simply compile information from *My Diary* that he sends to a selected health care provider¹ before a planned visit.

The scenario begins when Patrik suffers from increased fatigue and mood swings for some time. He logs into *My Diary* as usual and reviews the survey to see if he can identify any possible reason for the change. He discovers that it coincides with his blood pressure lowering drugs that were replaced by an equivalent preparation at last discharge date². Patrik checks the known side effects of the new drug³ and sees that the symptoms correspond quite well to his side effects. Patrik is relieved to get an answer to what may be behind his problems, but would like to discuss with his family doctor to maybe switch back to the previous drug. Since it is not an urgent matter he chooses to send a message with a request to his family doctor⁴. He picks out the relevant information from *My Diary* and shares it with his family doctor with a request if it would be possible to switch back to the previous drug⁵.

PART 2 Patrik's family doctor is notified that he received a new, non-urgent message from Patrik. At the end of the day, he reads the message and takes some of Patrik's diary information. He agrees with Patrik's assessment that it probably is the new drug that caused the change, but just in case he wants to schedule an appointment with Patrik before he changes the prescription. Therefore, he creates an appointment.

PART 3 Patrik is now on the road and gets a message to his smartphone. It says that he has new information in *My Calendar*, and therefore he logs⁶ into his mobile app. He now makes note of the new appointment and confirms that he can come at the suggested time.

¹*My Care Providers* must be linked to *My Diary*

²This requires a connection between *My Diary* and *My Medicine*. How should the visualization look like? Which information should it contain and what are possible parameters to be compared?

³Is it linked to patientfass (edition of the FASS (drug list) for patients) or 1177 from my medicine?

⁴Directly to the family doctor or to a proxy? Who manages the family doctor notices when he is not available?

⁵How do you choose which information to be sent? Are there certain pieces of information that can be packaged? How would you communicate the information? To be sent as an attached file, or the physician should have access to it via *My Diary*? Do doctors need a separate login to access this information? Should access be limited in time? How documents the physician in the patient record which evidence he had to give the advice?

⁶How is the login?

A.2 Concrete Scenarios

A.2.1 Scenario 1: *Patrik feels worse and wants to find the cause*

1a *Patrik writes in his diary about disturbing symptoms*

(based on PART 1 in A.1)

Patrik comes home from work. He suffered from increased fatigue today. He starts his home laptop to have a look in his diary as usual. Therefore he loads the bookmarked URL `www.minavardfloden.se`. He logs in using his personal number and gets to the welcome screen that gives him the choice of going to different services. He clicks on the link to *My Diary*.

An overview of today and the last days is visible. He can use the buttons left and right to scroll through the days. He sees that there was a 'medication event' (indicated by a small colored icon) a few days ago. He clicks on the icon and a box expands containing details of the drug event. He can read now, that on this day he changed to a new drug: he stopped drug x and started drug y. He wants to see the side effects of drug y and therefore clicks on its name. The graphical design changes (name *My Medication*, icon and color) and the view shows the information about the drug y (name, description, contraindication ...). He reads the side effects and realizes that they correspond to his symptoms.

By clicking the *Back* button of the browser he gets back to the *My Diary* view. The present day is highlighted and Patrik clicks on the button *New Entry*. A form appears where you can adjust the date and time, choose an entry category by means of a drop-down menu, and enter the content in a free text panel. There is a button to add references and a *Save* button as well. Patrick chooses 'mood' as entry type¹ and types a text in the content panel: "I felt tired as yesterday and had difficulty in concentration at work. I think this may be related to the new drug y I started last week". In order to draw the connection to the medication he clicks on the button *Add references*. Now the view changes a little (the entries in the diary get gray). When he moves the mouse over the entries respectively drug events they are highlighted and can be marked (e.g. small link symbol in the upper right corner). He moves his mouse to the drug event related to his new diary entry and clicks on it. For every entry or event chosen as a reference, a small icon occurs in the entry form at *References*. He clicks the button *Save references* (which replaced earlier the button *Add references*. If he clicks on the created icon representing the reference, the diary scrolls to the corresponding entry and highlights it. Finally, he saves his entry. Now in his today's diary page he can see his entry².

1b *Patrik wants to write a message to his doctor*

Patrik wants to inform his doctor about the issue in order to switch back to the previous drug. He is in *My Diary* and presses the *Share* button³. A *Share information* frame appears with three fields 'with whom', 'what' and 'message'. He clicks the *Add person* drop-down list in order to choose the person to share information with. Now he sees the names of his health care providers and chooses his general physician Ms. GP. This name appears in a text field at the right of the drop-down list. By clicking

¹there are different categories, e.g. diet, drinks, tobacco, exercise, mood, other ...

²Complete description or thumbnail text? When clicking on an entry the complete view frame could appear

³In order to write a message he could also follow the *Messages* link at the MVF start view

on the name "Ms. GP", Patrik gets the choices *Delete Receiver*, and *See details in My Care Providers*⁴.

Now he can choose which information he wants to share. Therefore, he can mark diary entries (by checking the little box in the upper left corner⁵) If he wants to choose many entries at one click, he can mark the day or week, for example. Then he adds some text in the panel: "Hello Ms. GP, is it possible to switch back to my previous drug x? What do you think about the following diary excerpts? Patrik". Now he shares the information by clicking the *Send* button (which got activated when a receiver was entered.) At the end he logs out.

(PART 2 in A.1 was not examined further since it does not concern the patient perspective.)

1c *Patrik gets a proposal for the next doctor appointment*

(based on PART 3 in A.1)

Patrik gets a message to his smartphone that says that he has new information in *My Calendar*. Therefore he logs into his mobile MVF app which he linked with a shortcut to his phone screen. He gets to the MVF start screen, sees a notification (red circle with a '1') at *My Calendar*, and taps on the link. The screen changes, he is now in *My Calendar* and above the month overview there is a frame with an appointment request. It is displayed who asked for the appointment, what it is about and where and when it should take place. There are two buttons *Confirm* and *Decline*. The request and the according day in the month overview are both highlighted in a special color⁶. In order to get a more detailed view of his schedule that day he taps on the suggested day and then the month view is replaced by a day's view. Patrik sees that there is nothing scheduled; so he confirms by pressing the *Confirm* button. Now the entry in his calendar is fixed and Ms. GP gets a confirmation.

A.2.2 Scenario 2: *Before the next visit*

One day before the planned appointment Patrik gets a message on his smart phone that reminds him of the scheduled time⁷. He starts MVF, logs in, gets to the start page and taps on the *My Calendar* link. He sees the month overview and taps on the day of tomorrow to remind him of the exact time. Patrik knows that sharing some health information before the appointment helps Ms. GP to better prepare. He taps on the MVF button in the upper left corner, gets to the start screen and clicks on *My Diary*. The screen shows the diary page of today.

Now he wants to compile the information of the last three days to share them with Ms. GP. Patrik taps the *Share Content* button and gets in the share view where he can now in the first step select diary entries. Every entry in the diary can be marked with a small checkbox in the upper left corner of the entry frame. Since Patrik wants to choose all entries of the week he checks the checkbox of the week⁸.

⁴Before changing the service, it should be made sure that the message does not get lost but is saved

⁵the checkboxes (at entry, day, week, and month) appear after having clicked the *Share* button

⁶If he wants to reply to the request later he can collapse (and later expand) the request details by clicking on *Appointment request*

⁷he could get to the *My Calendar* appointment info directly by clicking on a link in the mail?

⁸you can image that the physician has no time to read the complete diary excerpt of the patient. In order to reduce the amount of information the physician can filter the diary data by constraining time (e.g. only past

Patrik taps the *Continue* button that gets him to the next step: he can now choose the person with whom he wants to share the information. Having chosen Ms. GP out of a contact list (provided by *My Care Providers*) he taps *Continue* to get the last of the three steps: he can write a message. A keyboard is displayed and he types a little note "Hello, here is an extract of my diary. See you tomorrow. Patrik.", and then presses *Share now*⁹. He gets a confirmation that the information has been shared and gets back to *My Diary*.

A.2.3 Scenario 3: *After the visit*

During the visit at Ms. GP's they discussed his symptoms and finally decided to change back to drug x. In the office she showed him an information graphic about different reasons for fatigue. Patrik captured this with his smart phone and would like to store the photo in MFV. He logs in and navigates to *My Diary* where today is in focus. He clicks on *Attach file* and a file dialogue opens up. He searches his photo and confirms with *OK*. A small picture thumbnail appears at the present day¹⁰. He logs out.

A.2.4 Scenario 4: *Comparing parameters in the overview*

In order to better understand the origin of his tiredness Patrik wants to have a look at the MVF overview in his PC web browser. At the start screen he clicks the *Overview* link. He sees a timeline and the development of numerous parameters over time. He wants to compare his fatigue to his medication, his blood pressure, and his physical activity. In order to limit the displayed parameters he clicks on the *Preferences* button. Now he has the possibility to choose which parameters to display and in which manner. At the left side of the screen he sees a list with all parameters of all MVF services. At the right there is a list containing all parameters that are currently displayed in the overview. In order to deselect all parameters that are currently displayed he clicks on *Clear List*. Now this list is empty. He selects the parameter he is interested in and clicks the arrow button in the middle of the two lists to add it to the list of displayed parameters. In this way he chooses 'Physical Activity', 'Medication', 'Blood Pressure' and 'Fatigue'. He can change the order of the parameters in the list per drag and drop. So he can make sure that the curves of physical activity and fatigue are one below the other¹¹. Finally, Patrik clicks on the *OK* button which saves and applies the settings to the overview. Now the overview shows four selected parameters. He can adjust the displayed time interval in terms of length and position by using a widget positioned on the overall time line. Now he can see correlations and figure out that physical activity lowered his blood pressure, but also increased his fatigue.

three days) or category (e.g. only mood and exercise).

⁹Patrik is guided through the sharing process by an indication at which step he currently is. Besides the *Continue* respectively *Share now* button there is a *Back* button in each step.

¹⁰Is a file attached to a diary entry? Or is it standing alone?

¹¹When a parameter is selected in the right list it can be deleted by clicking on the red cross appearing next to the parameter name. Furthermore, you have the possibility of viewing and changing visualization settings, like the color and the type of visualization (e.g. graph). This can be done by selecting a parameter either in the left or the right list.

Appendix B

Tasks

B.1 Task Description

Table B.2 contains the description of the tasks and their successful completion.

B.2 Randomized Task Order

Test person	Task order
P1	A — B — C — D — E — F
P2	E — B — A — C — D — F
P3	A — E — C — B — D — F
P4	B — A — F — E — C — D

Table B.1: Randomized task order

Task		Description of Successful Completion
A	Find the 'yoga' entry. Open the 'yoga' entry in order to read the full text.	Click on text entry thumbnail of subject 'yoga'. [Detailed entry is displayed in the appearing text entry form on the right. (view D2)]
B	For the 18th may: Assess your fatigue as 'severe'.	Make sure the day of the 18th may is selected. Click on <i>New Diary Entry</i> . [Frame with the three options of entry types appears on the right. (view D4)] Click on <i>Assessment</i> . [Assessment entry form appears on the right. (view D7)] Choose name 'Fatigue'. [Drop down list with fatigue values appears.] Choose value 'severe'. Click <i>Save</i> . [Entry thumbnail is displayed in the diary day.]
C	For the 17th may: Change the tobacco consumption to 5 cigarettes per day.	Click on the tobacco entry thumbnail of the 17th may. [Detailed entry is displayed in the appearing assessment entry form on the right. (view ~D1)] Change value to 5. Click <i>Save</i> . [Entry thumbnail is updates in the diary day.]
D	For the 16th may: Delete the attachment entry.	Click on the attachment entry thumbnail of the 16th may. [Detailed entry is displayed in the appearing attachment entry form on the right. (view D3)] Click on the <i>Delete</i> button. [Entry form and entry thumbnail in the diary day disappear.]
E	For the 18th may: Create a new text entry. Enter entry subject: 'Delix 5mg'*. Enter entry content: 'probably causes my severe fatigue'. Create a tag 'drug'.	Click on <i>New Diary Entry</i> . [Frame with the three options of entry types appears on the right. (view D4)] Click on <i>Text</i> . [Text entry form appears on the right. (view D5)] Enter subject. Enter content. Enter tag in the New tag field and press <i>Enter</i> . [Tag appears in the tag box.] Click <i>Save</i> . [Entry thumbnail is displayed in the diary day.]
F	For the 16th may: Find the 'Tennis' entry. Delete the tag for this entry.	Click on text entry thumbnail of subject 'tennis'. [Detailed entry is displayed in the appearing text entry form on the right. (view ~D2)] Click on the <i>Delete</i> button of the tag. [Tag disappears.] Click <i>Save</i> .
The referred views D0 to D7 are presented in section 5.1.3. The tilde (~) means that the view is not exactly identical and that the content in form fields or some highlighting can be different. *drug to lower blood pressure		

Table B.2: Tasks performed in the cooperative evaluation sessions and the corresponding description how to complete them.

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